Concrete

Vol. 36 Chicago, May, 1930 No. 5

Overcoming Paving Difficulties in West Virginia

Half-at-a-Time Construction in Mountain Roads—Selecting Stable Locations in Coal Mining Regions—Much Trouble With Earth Movements—Hillside Slides Are Maintenance Problems—Earth Embankments on All Curves—Use of Commercial Curing Agents

ROAD construction in West Virginia has long been known among road builders as a "tough" proposition. This deference has not been lightly accorded, but in the face of competition from states where climate is worse, or mountains steeper, or materials poorer, the general all-around cussedness of nature has given the palm to West Virginia.

Topography of the State

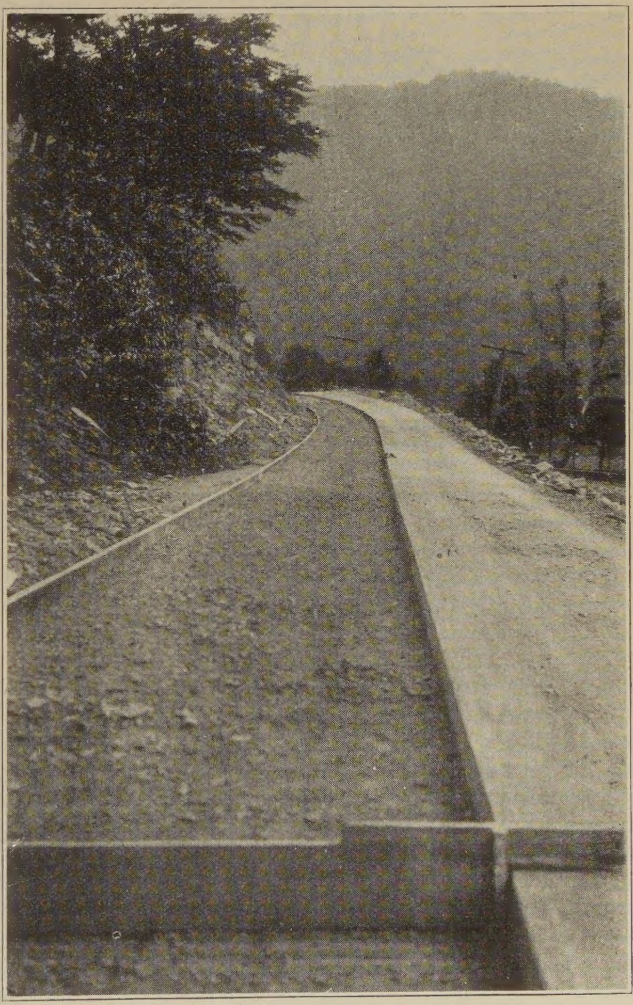
The topography by the state is responsible for most of the difficulties. Generally speaking, the state is of a rolling nature distinctly mountainous in the eastern part. From the Ohio river on the west to the Allegheny mountains on the east the land rises steadily and irregularly. This condition makes four distinct physiographic regions—the Ohio valley region, where altitudes run from 500 to 1,000 ft. and where the land is rich and thoroughly cultivated; the Cumberland plateau, with altitudes from 1,000 to 2,000 ft. and containing most of the state's important cities; the Allegheny highlands, where the altitudes range from 2,000 to 4,000 ft. and where the topography is exceedingly rough and the population is scarce outside the rich mining districts; and the Potomac region, which consists of five counties sloping downward from the mountains to the town of Harpers Ferry, the lowest point in the state.

Each of these sharply divided districts presents road design and construction problems of its own. This article deals with two districts in particular—the two northern districts with respective highway department headquarters at Keyser and Morgantown. The Keyser district is under the direction of B. E. Gray, and the Morgantown district under W. S. Downs. These districts are known officially as Districts Number 4 and 5.

State Builds High Type of Roads

West Virginia is, first of all, a builder of roads of high type. This statement is verified by mileage tables, which show that at the end of 1929 there were about 600 miles of gravel, about 700 miles of bituminous macadam and 700 miles of concrete. It is in the construction of its concrete roads that the state has shown remarkable ingenuity in design and perhaps even more remarkable ingenuity in construction.

Under the engineering organization in effect in West Virginia the district engineer is held responsible for the task of designing road types best suited to the topography



Roads in mountains must be built half at a time, the side not under construction being kept open to traffic and the geology of his district, and deciding upon the best methods to employ.

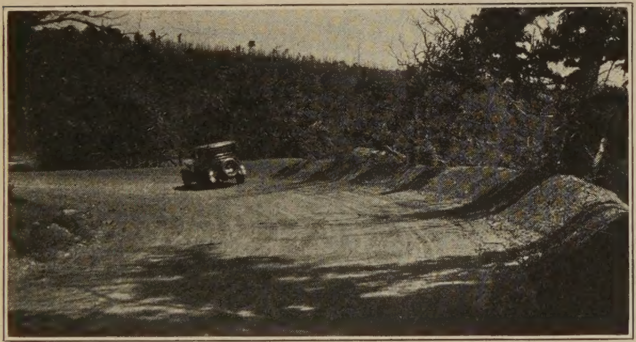
District No. 5 Includes Allegheny Highlands

The district presided over by B. E. Gray comprises ten counties lying along the crest of the Allegheny highlands and encompassing the Potomac region. This district is known as the eastern "panhandle" because it juts out into Virginia and Maryland. With the exception of the five small counties lying around Harpers Ferry, the district is mountainous and rugged, and road building and maintenance calls for constant engineering alertness.

Concrete road construction in District Number 5 is most difficult. Roads are few and far between. Closing even one road throws a heavy burden on all others in the district, especially on the through routes which cross this part of the state from east to west. This has led to "half-at-a-time" construction and the development of especially interesting methods of keeping traffic moving during construction.

Subgrades Built Two Years in Advance

Because of the mountainous country and the uncertain subgrades encountered, the district constructs its subgrades at least one year ahead of paving. Slides and movement in the roadbed are every-day occurrences. Any pavement laid on new subgrade is almost sure to settle or move out of alignment. Once the subgrade is built, traffic is turned over the road and kept on the new location during the settling period. This serves to compact the subgrade; but what is of more importance, it serves as a guide to the probable future action of the terrain. When paving time comes the holes made by traffic are filled and a new contour is given the base. Under these conditions the subgrade is usually in first class condition when the pavement is laid.

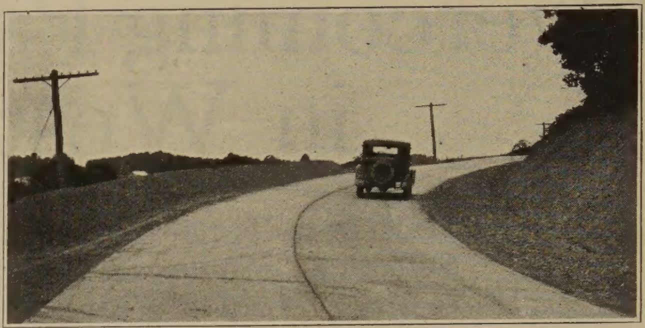


Finished subgrades are thrown open to traffic and allowed to pack and settle for two winters before concrete pavement is placed. Note earth embankment that serves as a guard rail

Grading Is Biggest Job

In District 5 grading is usually a big job. The engineers feel that any grading job entailing less than 15,000 yds. of material to the mile is an easy job and below average conditions. Taking figures over a period of years, the grading usually means the moving of from 15,000 to 50,000 cu. yds. of material. Much of the work is in rock formation, unstable in many cases and prone to slide in others. Heavy cuts and equally heavy fills are customary, while grades and curves account for much of the preliminary expense in road building. Curves are frequent and usually a problem. It is the endeavor of the engineering department to build these curves in accordance with the requirements of modern driving. Curves are banked, sometimes as much as 36 in. Curves are made with as long a radius as possible, although this feature often has to be sacrificed for location.

Motorists using West Virginia highways are always impressed with the embankments built around curves and along sides of cuts or along the drop side of side-wall roads. This embankment takes the form of a heavy-base bank with a curve approaching a parabola. This ideal section is impossible to build, but the resulting bank has been found an exceedingly good preventive against accident. The state builds these banks for about ten cents a foot as against a cost of fifty to seventy-five cents a foot for guard rail.



The earth embankment on the left is much less expensive than concrete guard rails commonly installed at curves

Good Quality of Concrete in Pavements

The concrete pavements in District 5 are uniformly 7 in. thick, reinforced with mesh weighing 44 lbs. per sq. yd. In 1928 56-lb. mesh was used, but the lighter weight is proving satisfactory.

Quality concrete has been found the best method of combating the conditions which tend to destroy pavements. The mix is designed on a water-cement ratio basis to give a concrete of 3,000 lbs. per sq. in. crushing strength. Six gallons of water per sack of cement is specified and with good grading 3,500-lb. concrete has consistently resulted.

Local Gravel as Coarse Aggregate

While the state abounds in good limestone, plants located conveniently for road building are few, and hauling costs are high. Gravel is accordingly used as the coarse aggregate for most of the concrete. Roads built several years ago of both gravel and stone show that under West Virginia conditions the stone aggregate gives a slightly better wearing pavement. This slight advantage is more than offset in most cases, however, by the lower cost of the gravel. The fine aggregate commonly used is river sand, which has always been clean and hard. No trouble has been experienced with undersized or oversized particles, nor has sand film been encountered.

In 1928 the engineering forces attempted to keep material grading such that a 1-in. slump was averaged. This experiment resulted in high-strength concrete, but increased the difficulties and the costs of finishing. With the opening of the 1929 season a 2-in. slump was again permitted, and this has proved satisfactory. Finishing is cheaper and easier, and better riding surfaces have resulted.

Central Mixing Plant System Favored

In District 5 several methods of mixing have been tried, with results thus far indicating a superiority for the central mixing plant system. It is not questioned that under other conditions other forms of mixing might be successful, but under the difficult conditions of subgrade and traffic requirements in West Virginia, central mixing has simplified matters. Experiments showed that pneumatic tired trucks were most successful in view of the unstable soil and movement in hillside locations. These trucks cause no harm to the subgrade. Central mixing has furthermore eliminated much of the trouble from operating mixers far from water supplies, on mountain grades and on narrow rights-of-way. Hauling mixed batches seems to present little difficulty, for in this district hauls of 4½ miles have been common.

Water Supply a Serious Matter

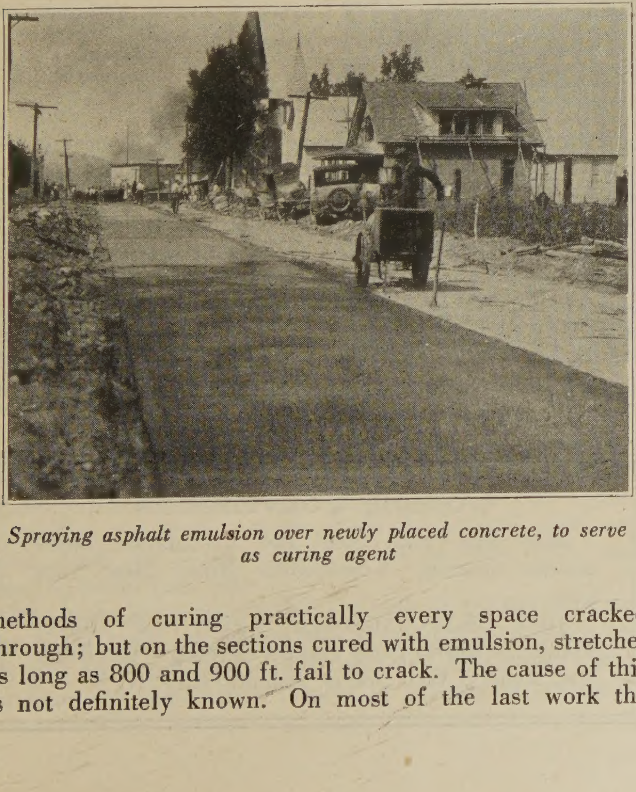
In northern counties adequate water supply has frequently proved a problem of real gravity. Wells are not close together and streams supplying sufficient water are far apart. On some of the jobs water has had to be pumped by step reservoir methods for as much as 6 miles. The pipe materials alone on such a long line represent quite an investment. In operation they often prove a source of mixer shutdown and delay.

Aside from mixing problems, this scarcity of water has made curing a difficult problem. Ponding has been almost impossible because of the scarcity of water. In addition, ponding is further complicated by the grades and curves of the mountain country. Wet earth and straw have been tried, and when plentiful water supplies are at hand these materials have been found well suited to the needs.

Solving the Curing Problem

Calcium chloride has been tried; but it was found that the sudden heavy rains in the high altitudes, aided by the heavy winds, swept this material off the pavement, making curing spotty. Within the last two or three years emulsion curing agents have been tried. These curing agents have proved well suited to the conditions encountered, for they do not require water and become an integral part of the surface.

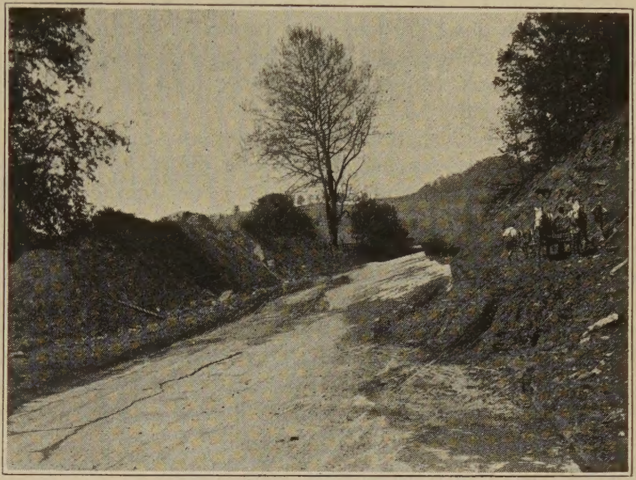
One of the interesting results of emulsion curing has been brought out in connection with expansion joints. The specifications do not call for expansion joints as ordinarily designed. Every fifty feet, however, a space is left between the sections of the reinforcing mesh and these spaces are supposed to crack through the slab, providing joints for expansion and contraction. Under ordinary methods of curing practically every space cracked through; but on the sections cured with emulsion, stretches as long as 800 and 900 ft. fail to crack. The cause of this is not definitely known. On most of the last work the center joint is a submerged joint with filler finished over and with the top left to crack as it will over the plate.



Spraying asphalt emulsion over newly placed concrete, to serve as curing agent

District No. 4 Comprises Coal Fields

District Number 4, comprising twelve counties, lies to the west of District 5, and while its eastern part is mountainous it slopes downward toward the Ohio valley in long rolling ridges. In this district lies the northern end of the great coal field of the state. It is in West Virginia that the Appalachian coal field reaches its greatest width—100 miles—and it is here that one seam underlies another. In all, some 85 seams are found in the state.



Earth slides are troublesome problems in maintenance. This concrete slab was raised 5 feet

Settling and Sliding of Ground Surface

Mining has been carried on for many years in the state and practically all counties in District 4 are actively engaged in mining. This activity has undermined the territory with a honeycomb of mining galleries which cause settling and changing contours of surface land. This territory has also been the subject of intense study by officials because of its extensive and peculiar land slides. Fighting these slides, in which entire mountain sides have been known to move downhill, taking roads and substructures along with the slide, constitutes a troublesome problem in maintenance.

An interesting feature in connection with this soil movement is the unlooked-for elasticity of a concrete pavement. This elasticity has led to the adoption of somewhat unusual practices in reinforcing the slabs. The engineers have come to know just where probable movements will take place, and when another location is impossible extra reinforcing is incorporated. In West Virginia reinforcing is bid in at so much a mile, or by the job, and prices quoted cannot take into account sections of road where more or less steel is needed. Consequently the practice followed is that steel is saved in stretches where it is not urgently needed and the accumulated excess is put into the slab where a movement is likely to occur. This system has worked out very well.

Investigations in erosion and hillside movement have determined that most of the trouble lies with the character of the geological formation. Strata of sandstone and limestone are overlain and underlain with layers of shale. This shale is in most instances impervious, while the sandstone and the limestone are usually badly shattered. Water percolates through the stone to the surface of the shale, where it forms a lubricated layer upon which all material above can slide. The heavy rainfall of the region adds to the trouble.

Outwitting the Earth Movements

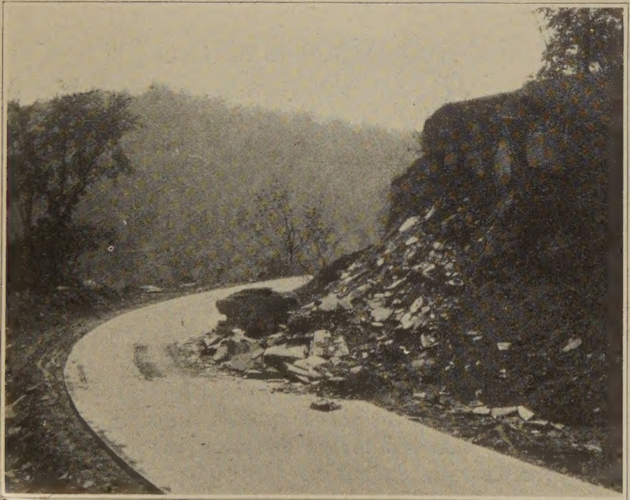
Many forms of attack have been tried and most of them have proved impracticable. It was once thought that blasting would break up the layers upon which the mass moved, but this means was not successful. Investigations have since established that much of the mass actually flows and can move over blasted planes as well as over smooth planes.

One customary method used in other states is the use of piling driven down to firm soil. But in West Virginia the masses of detritus are so great that piling seldom proves feasible. French drains, too, offer too little relief for the money expended.

Location has been turned to as the only means of preventing the great expense involved in efforts to overcome the force of slides and settlement. The engineers have come to know where a road can be placed to remain set. Many of the seemingly long swings of location in the state are due to the knowledge that any other location would lead to trouble. Fill cannot be depended upon, for water working down along a lubricated plane is apt to carry the fill right out from under the slab. Cutting the subgrade back into rock or locating right-of-way along the ridges or in the valley bottoms is the engineer's only assurance that his road is there to stay.

Design and Construction of Pavements

The concrete pavements laid in District 4 are 7 and 8 in. uniform thickness. Seven inches in the minimum and 8 in. is the more usual. The reinforcing used is $\frac{3}{8}$-in. bars placed in both directions and in varying amounts according to the arrangement described before.



Typical slide at a cut. Erosion of the shale stratum below the limestone stratum caused the latter to fall

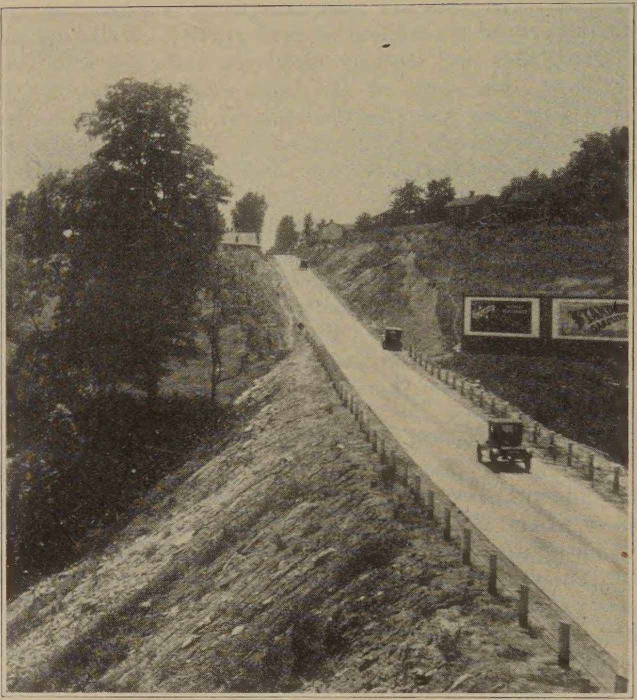
Aggregate Used

As in District 5, several kinds of coarse aggregate are used—slag, gravel, stone—but gravel most commonly. And similarly to District 5, the stone aggregate holds up best, but is about twice as expensive as gravel and hence not used extensively. The slag has not had time to prove itself, but has not shown characteristics which warrant its adoption above gravel, all things taken into account.

The engineers of District 4 have made considerable research into various methods of proportioning and have adopted weight measurement as best suited to conditions. This control of the batches is backed up by laboratory investigation of materials, the state maintaining an adequate materials testing laboratory. Before a contractor starts work he submits to the laboratory samples of the materials which he proposes to use. If the materials are satisfactory the laboratory works out a mix he can use to get the strength required.

Extensive Tests of Curing Methods

Curing is just as important in this district as in District 5, and investigation has been carried even further. A 9-mile test road was built in which all methods of curing were tried. Beams and slabs were cast and cured under road conditions and broken to show results. Wet earth and sprinkling showed the best results where favorable conditions for these methods prevailed. Special integral and applied curing agents formed a second group somewhat below Group 1 in strengths developed.



This location, requiring heavy cuts and fills, was selected because the ground is stable here

Financing Methods

This interesting road work is the result of years of experiment and construction, with changes in design and methods as new findings came to light. At the present time road work is supported by a 4-cent gasoline tax and two bond issues. The first bond issue was for $50,000,000 and was authorized in 1924. This sum was expended by the end of 1927, but by that time $11,000,000 had been retired and that amount was reissued. This reissuing of retired bonds is a feature of highway finance in the state. The second bond issue was for $30,000,000. The state's present income from gasoline tax and license fees is sufficient to amortize a road debt of $85,000,000.

Coming Conventions

May 9th—Rail Steel Bar Association, semi-annual meeting. Commodore Hotel, New York City.

June 23-27—American Society for Testing Materials, thirty-third annual meeting. Chalfonte and Haddon Hall hotels, Atlantic City, N. J.

Detroit Concrete Block Plant on Large Production Basis

Plant of R. E. Hamilton's Sons, at Rademacher and Desmond Aves., in Detroit, Has Modern Equipment—Overhead Conveyor System a Special Feature—Automatic Block Making Machinery Installed — Few Employees Required — Deliveries Handled in Expeditious Manner

By **M. B. WILLISTON**
President, R. E. Hamilton's Sons, Inc., Detroit, Michigan

THE concrete products manufacturing plant of R. E. Hamilton's Sons, Inc., located at the corner of Rademacher and Desmond Aves., in Detroit, is arranged and equipped for the manufacture of all sizes and shapes of solid and hollow concrete units on a large production basis.

The company manufactures both gravel concrete and cinder concrete units in a complete line of more than fifty different sizes and styles. In addition, art stone, chimney blocks, pier caps, sills, coping tile and related specialties are made. Aside from the various sizes and types, units are manufactured either in plain face, rock face, or panel face type.

The plant has a production capacity of 18,000 units per day in the main building where gravel concrete block and tile are produced, and 7,000 units per day in the cinder concrete unit department located in a separate building.

Location of Plant

The plant is well located with respect to transportation and delivery facilities. As indicated in the ground layout here illustrated, the plant is served by a spur track from the main line of the Michigan Central Railway. The location is about 4 miles from the downtown section, and is centrally located with respect to a large market in the western and northwestern portion of the city. Well-paved streets and roads are available in all directions for delivery by trucks.

A general view of the plant and the open-air storage yard may be seen in Figure 1, while the ground layout is shown in Figure 2.

As indicated in the ground layout, the company deals in general building materials as well as in the manufacture of solid and hollow concrete units. The ground layout, however, indicates quite clearly the buildings and

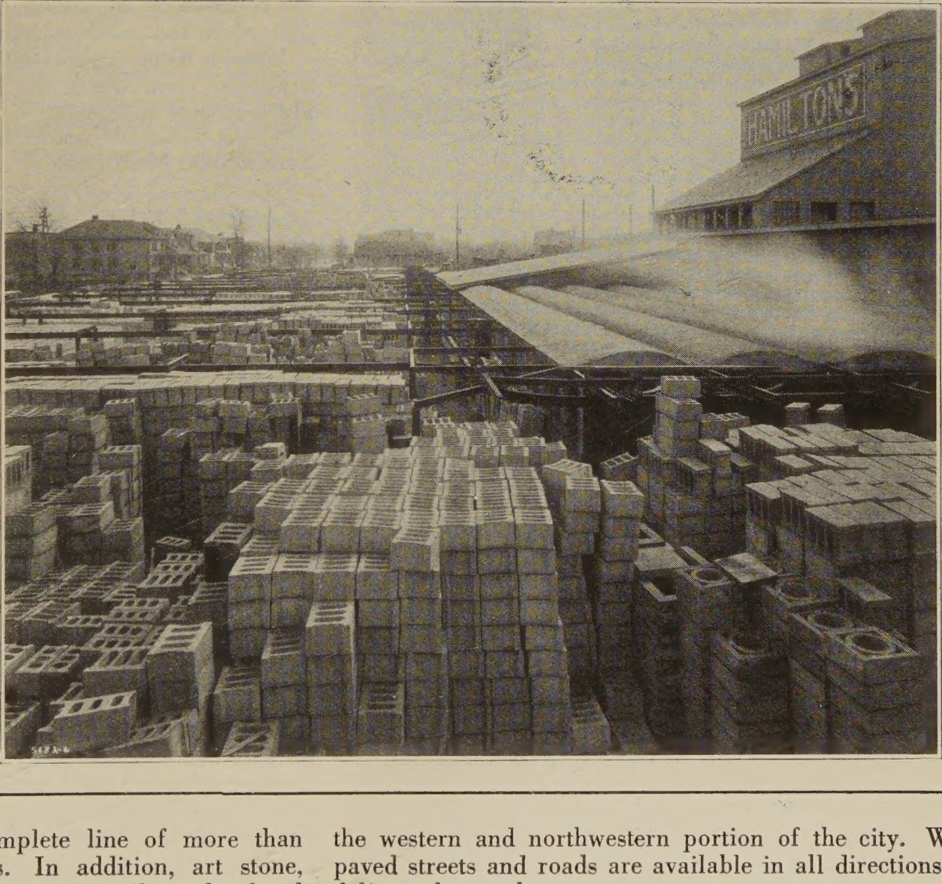


Figure 1. General view of R. E. Hamilton's Sons concrete products plant in Detroit. The curing kilns are seen at the right

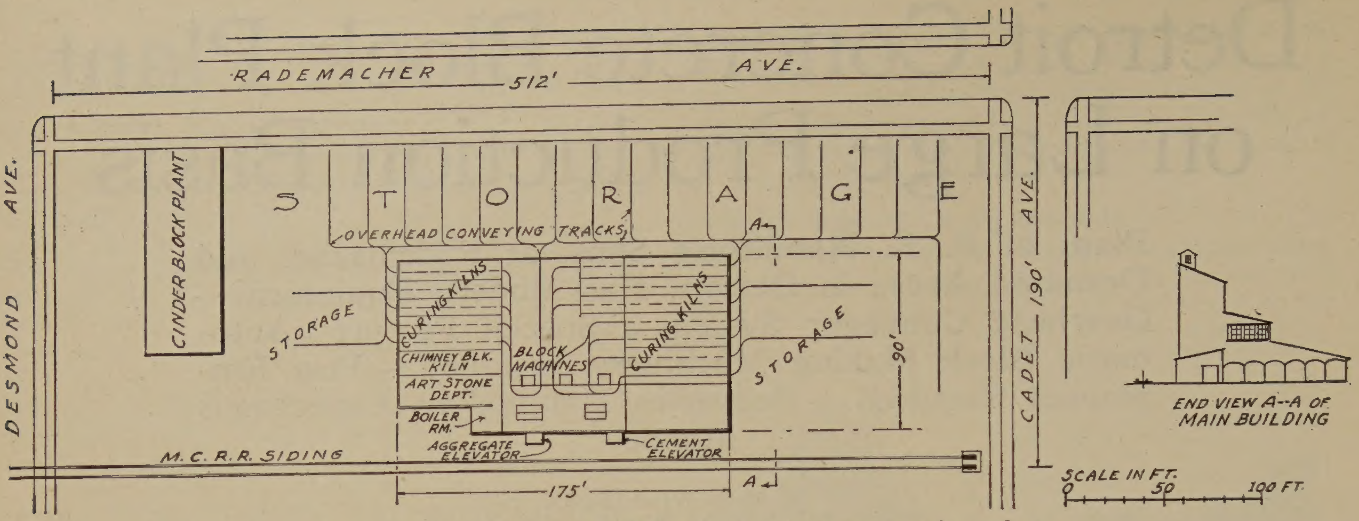


Figure 2. *Ground layout of R. E. Hamilton's Sons concrete products plant*

storage yards used in the manufacturing operations.

Material-Handling Facilities

Lake sand and gravel are delivered from a source about two miles away, by truck, dumped into a pit alongside the main building and conveyed directly to two bins in the upper part of the building, each with a capacity of 70 cu. yds. During the winter, both sand and gravel are delivered heated.

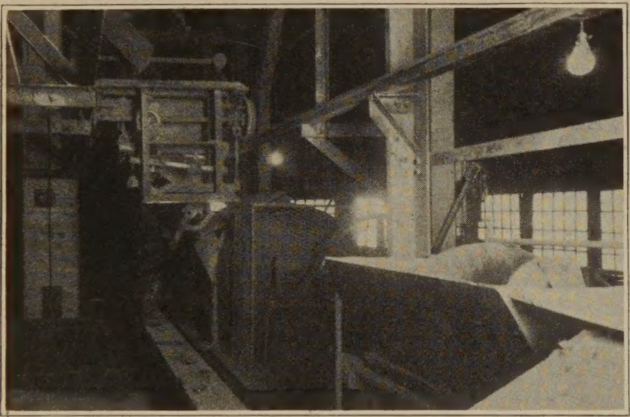


Figure 3. This overhead mixer charger receives aggregates and cement direct from the storage bins and discharges the dry batch into any of the mixers

Portland cement is delivered in bulk, by truck, direct from the mill where it is manufactured. It is likewise conveyed to a bin having a capacity of 120 barrels, and located in the upper part of the main building.

The bucket conveyor used in delivering sand and gravel to the bin has a capacity of 36 cu. yds. per hour. The conveyor used for delivering cement to the storage bin is a continuous bucket elevator type with screw conveyor feed.

Proportioning and Mixing

Four mixers in the main building, located at the second floor level but below the storage bins, each supply an automatic block-making machine. A fifth mixer serves the cinder block machine in another building. Two of the mixers in the main building each have a capacity of 30 cu. ft., one has a capacity of 21 cu. ft., and another 14 cu. ft. The mixer in the cinder unit plant has a capacity of 21 cu. ft.

A mixer charger operating on an overhead track may be shifted back and forth, as required, to receive material from the sand, gravel and cement bins and deliver it to any of the mixers. This charger is shown in one of the illustrations, designated as Figure 3. The materials are proportioned by weight, the equipment being of a type which automatically shuts off the flow when the desired weight has been discharged.

Immediately above each mixer water is supplied through a perforated pipe under city pressure. The amount of water is controlled by the man at the mixer, who judges the consistency by taking out and examining small samples while the concrete is being mixed.

When a batch is thoroughly mixed, it is discharged into a hopper from which the fresh concrete is fed into the block-making machine.

The Block Machines

The block-making machines in the main building and in the cinder block department, as well as the mixers and the material-handling equipment, are all of Besser manufacture. The block machines in the main building consist of two automatic standard strippers each producing 6 units per minute, and one master tamper producing 4 units per minute. In the cinder unit plant there is one automatic super-stripper producing 8 units per minute.

Figure 4 shows three of the block-making machines in the main building. The machine nearest the camera is the master tamper and the two to the right are the standard strippers, each producing 6 units per minute. This view shows the hoppers above the block machines into which the mixers dump the freshly mixed concrete. The mixing floor and two of the mixers may be seen in the upper part of the picture.

All of the block-making machinery is of comparatively recent installation and is of the complete automatic type requiring very little attention from the operator.

Electric power supplied by the Detroit Edison Company is used for all power-driven equipment in the plant, including mixers, block machines and bucket conveyors.

Removing the Newly Made Block

The facilities for removing the newly made block from the machines are well illustrated in Figure 5. Two block racks are set side by side on a small revolving platform which can be seen quite clearly in the illustration. The man removing the block from the machine fills one rack, when the platform is immediately revolved to the amount of 180 degrees. This rotation brings the empty rack next to the block-making machine and the loaded rack on the other side.

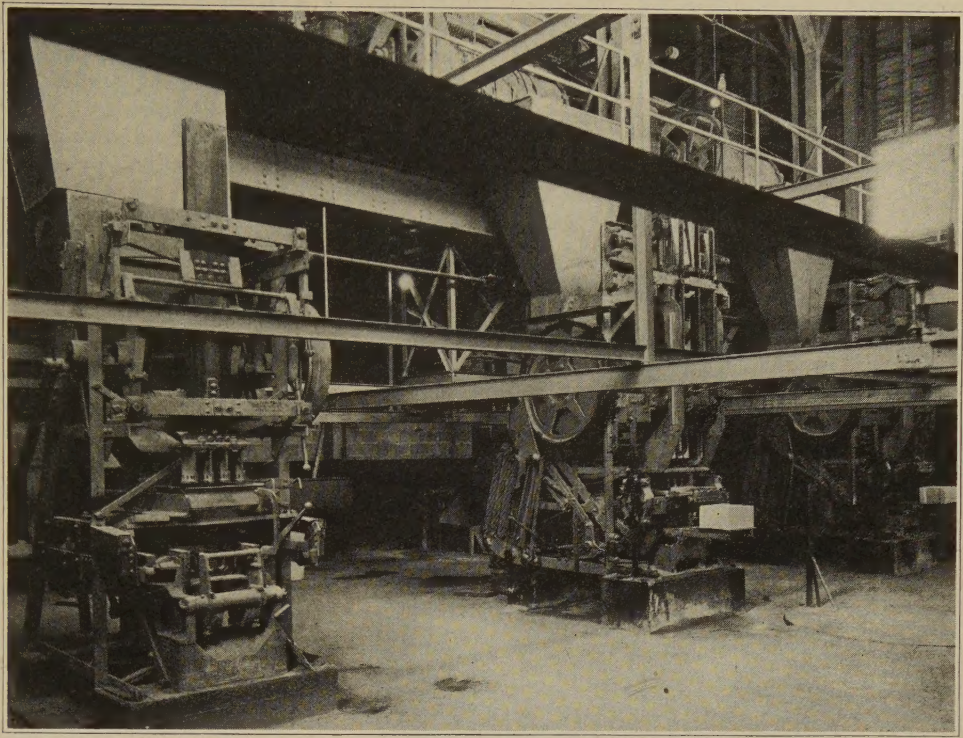


Figure 4. Battery of three automatic block-making machines in main building

Transporting the Concrete Units

At this point one of the most interesting features of this plant comes into play. The Louden overhead monorail system is used in transporting the newly manufactured units from the machine to the curing chamber and later from the curing chamber to all parts of the open-air storage yard. Each trolley has 8 small wheels which run on the lower flange of a continuous I-beam. This I-beam is bolted to other beams within the building, while out in the storage yard it is bolted in a similar manner to a short cross-beam which in turn is supported by two 4-in. iron stanchions.

In Figure 5 one of the trolleys is shown in position, about to pick up a loaded rack near the machine. In Figure 6 another trolley may be seen in the open-air storage yard, where a rack has just been unloaded and is now ready to be returned to the building.

In the Curing Chambers

At the block machine a newly loaded rack is picked up by the trolley and pushed to the curing chamber, where, after being turned cross-wise of the kiln, it is let down on the floor, the blocks being left on the rack.

The units remain in the steam curing chamber approximately 24 hours, after which the loaded racks are again picked up by a trolley and pushed to any desired location in the yard.

The temperature of the curing kilns is maintained at about 140 degrees Fahrenheit. Twelve kilns are used, each 6 ft. 6 in. wide and of varying lengths but totaling 800 lin. ft., so that curing facilities are adequate for the maximum rate of production.

Provision Against Cold Weather

The effect of cold weather is in part overcome through the purchase of heated aggregates which, as previously stated, are delivered by truck, in a heated condition. By promptly conveying the material to the elevators a comparatively small amount of heat is lost before the material reaches the storage bins overhead. The bins are then kept covered with tarpaulins.

Facilities are also provided for heating the water during extremely cold weather, although the main provisions

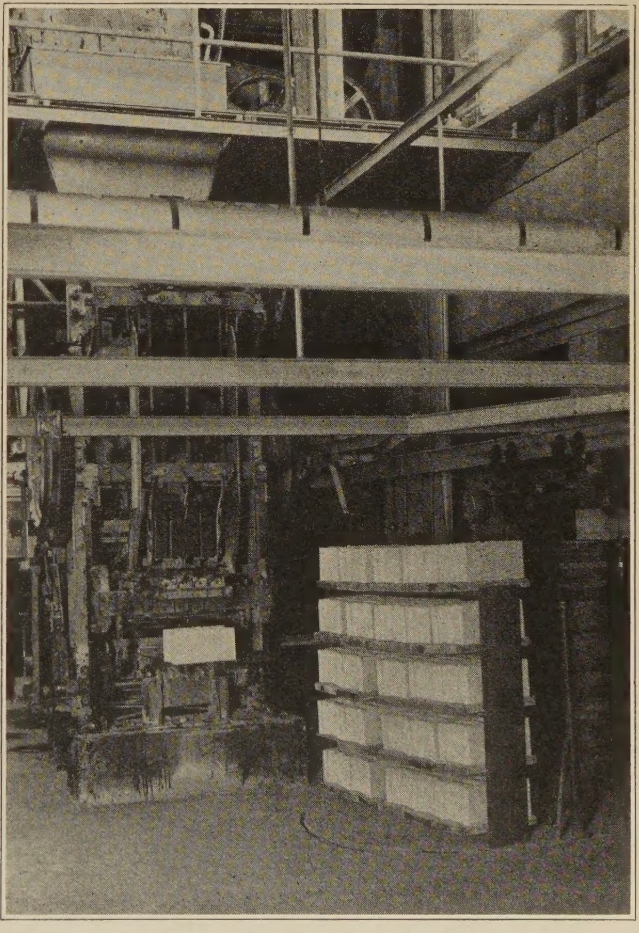


Figure 5. Two block racks side by side on revolving platform next to block machine

for overcoming cold weather are found in the fact that the manufacturing operations are within enclosed buildings and that the early curing period takes place within the steam curing chambers, where outside temperature conditions are of little concern. When manufacturing is carried on during extremely cold weather, the practice is to leave the units in the curing kilns for about 48 hours instead of the ordinary 24-hour period.

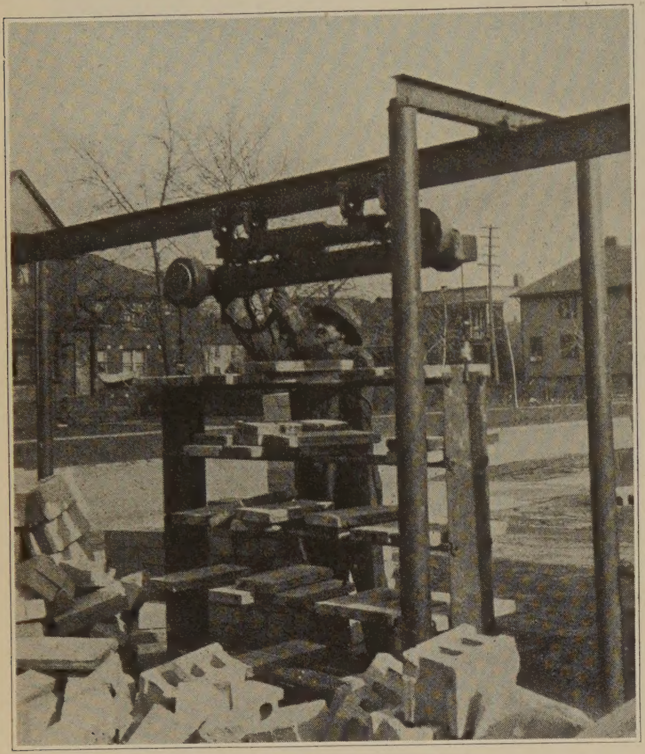


Figure 6. Overhead trolley conveyors carry block to steam room and to all parts of storage yard

Delivering Block and Tile

The receipt of orders and the dispatching of block and tile are handled in a separate building across the street from the main office building. This work is in charge of a superintendent, assisted by two dispatchers. For delivery of concrete units, the company owns nine 5-ton trucks, sixteen 3-ton trucks, and three 2-ton trucks, supplemented by 22 trailers. Additional truck equipment is hired during rush periods, if necessary. The order department is open from 6 o'clock in the morning until 10 o'clock at night. The delivery trucks are loaded during the night and the entire fleet is started on deliveries early in the morning. This early start with the loaded trucks permits the maximum use of the company's motorized equipment.

The company makes no special delivery charges, but makes a flat price for delivery to any point within the city limits. A special delivery charge is made in cases where units are hauled a long distance outside the city.

Repair Shop and Testing Facilities

Because of the fact that the city of Detroit operates a materials testing laboratory and the further fact that other commercial testing laboratories are available, this company has not installed testing equipment of its own. There is, however, a completely equipped repair shop for keeping equipment in order.

Small Number of Employees

The entire block manufacturing operations are handled by a plant superintendent and 20 men. This small number is made possible by the use of automatic conveying and manufacturing equipment to the highest degree.

The office force consists of two men in the credit department, four men in the bookkeeping department and two girls who do general office and stenographic work, but the office force also handles the company's general building material business.

The order and dispatching department, as previously stated, is handled by one superintendent and two dispatchers.

The number of truck drivers depends, of course, upon the number of trucks in actual operation.

The Sales Force

This company has a regularly organized sales force, consisting at present of a sales manager and eight salesmen. The salesmen employed are high class and experienced men who are kept thoroughly informed as to the nature and quality of the product they are selling.

Increase in Federal Aid Funds

The Dowell-Phipps bill increasing federal aid for highways from $75,000,000 to $125,000,000 has passed both houses and was signed by the President on April 4th. The amended bill provides that the limitation of payment which the Secretary of Agriculture may make can be increased to $25,000 per mile exclusive of the cost of bridges on more than 20 ft. clear span; provided, that the federal participation shall be limited to $15,000 per mile until the original certified 7 per cent system of such states shall have been surfaced; provided further that any such increase above $15,000 per mile shall be certified by the Director of the Bureau of Public Roads and the Secretary of Agriculture as securing actual extensions of the highway system or economy in its construction. This increase in federal aid funds should have quite an influence on road awards in many of the states.

Cinder Block Again Prove Ability to Withstand Fire

Cinder block again proved their fire resistive properties in a test conducted for the benefit of state engineers recently at Harrisburg, Pa.

Two structures of like design were erected of cinder block and building tile. Oil soaked lumber set afire within them brought the temperature in the former to 1,818 degrees and in the latter to over 2,000 degrees. Examination after cooling is said to have shown the fire to have had no effect whatever upon the cinder block walls.

The Harrisburg Building Block Company, of that city, furnished the units.

Nineteen "Trade Practice Rules" Published by Mixer Industry

Nineteen "trade practice rules" for the promotion of better business practices in the distribution of its products have been formally adopted and published by the organized Concrete Mixer and Paver Industry, with offices at Washington, D. C.

Through means of a permanently functioning trade practice committee, it is hoped to obtain widespread acceptance of the rules and their continued observance.

The 1930 Book of Standards

The 1930 Book of A. S. T. M. Standards, issued triennially in two volumes by the American Society for Testing Materials, is expected to be available for distribution some time in October of this year.

Developments in Concrete Aggregates

Better Control of Proportions in Central Mixing Plants—No Apprehension About Elapsed Time Before Placing—Much Larger Coarse Sizes in Massive Work—Vibratory Tampers Improve Placing Methods—Moisture Determination Being Simplified—Research Work Continues, But Further Studies Needed

By HERBERT J. GILKEY
Associate Professor of Civil Engineering, University of Colorado

Improvements in technique in control and placing of concrete was one of the prophecies made for the future by Herbert J. Gilkey in his article "Concrete Aggregate" in the March, 1929, Forecast issue of "Concrete."

Now, slightly more than a year later, Mr. Gilkey tells of developments that have come to pass in that time and those that are likely to follow.

DEFINITE progress is perceptible in the general field of concrete aggregates after the lapse of a year. The past year's most clearly defined attainments may be considered under the following headings:

1. Progress in technique;
2. Progress in research;
3. Expansion of the field.

1. Progress of Technique

The central mixing plant, properly designed and used, has often been mentioned as being one of the most promising of urban developments in the technique of using concrete. From the standpoint of aggregates the central mixing plant is deemed important because it gives promise of better controlled grading and the benefit of cumulative experience regarding the mixing and placing characteristics of concrete from local aggregates. There appears to be no falling away from the central mixing plant idea. The mixer truck promises to assist in the prevention of segregation in transit and in cases of long hauls may perform the entire mixing operation on the road.

Work by Gonnerman and Woodworth[1] has so fully clarified the subject of "retempered concrete" that there need be no apprehension concerning the elapsed time between mixing and placing, providing initial stiffening has not set in. Recognition of the fact that for most cements and moderate temperatures an elapsed period of several

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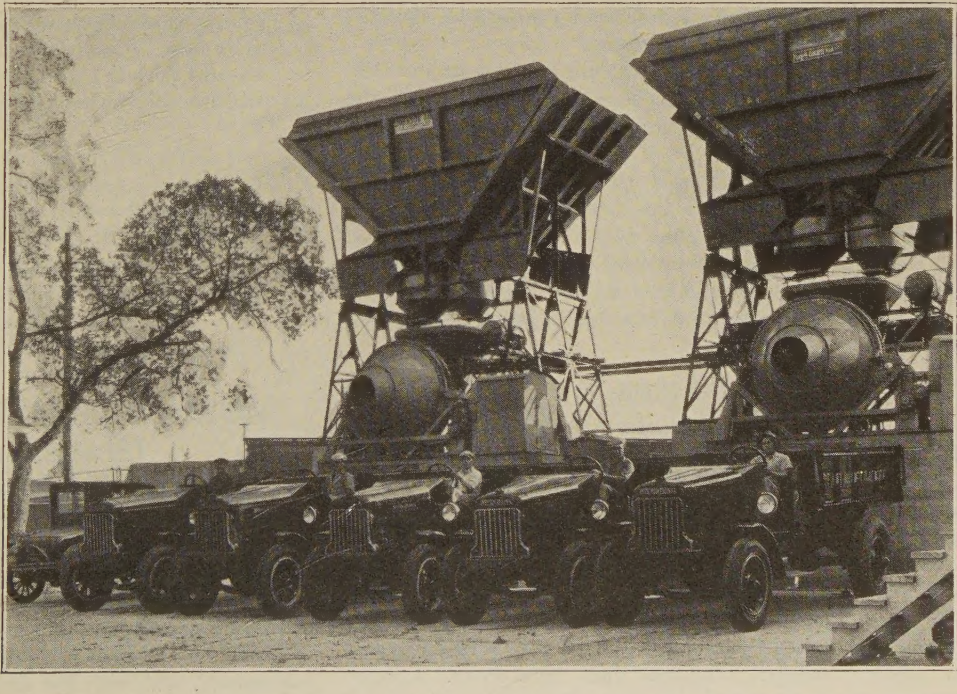
[1] *Proc.* Amer. Concrete Inst. 1929 pp. 344-387.



Increasing use of ready-mixed concrete is an important factor in better control of quality and proportions of aggregates hours is not objectionable, will remove much of the former prejudice against centrally mixed concrete. Additional emphasis is being placed upon the desirability of having the placing under the direct control of, if not actually performed by, the same agency as that which mixes and delivers. Lack of co-ordination of consecutive functions entails delay, friction and wastage.

The tendency to use plums in massive concreting operations seems to be giving way to some extent to the use of larger limiting sizes of coarse aggregate. Concrete mixers that will take fragments as large as 8 in. in diameter are now in service.

The use of vibratory tampers is being extended to the placing of concrete, in mass work. These make it possible to attain adequate placement for much drier and harsher mixtures than could be properly manipulated by ordinary means. It is being realized that harshness and unworkability are relative terms that depend partially upon the proportions of aggregate and water and partially upon placing methods.

Devices for rapid moisture determinations in aggregate are being improved. There are prospects that this irritating variable may soon be reduced to an easily handled detail of routine.

Proportioning by weight continues to gain in favor.

2. Progress in Research

Originally a concrete was supposed to be fully defined when the cement-aggregate ratio was known. Then the aggregate was completely washed out of the picture and one obtained the impression that water-cement ratio and 28-day compressive strength were the only ingredients that mattered. During the past few years the aggregate has been coming back to occupy the modest middle ground to which it is probably entitled. It is being recognized that durability, workability, placeability, yield (and therefore economy) and imperviousness are properties on which the aggregate exerts much influence, greater than its influence upon strength in many cases. There is a general feeling that there are still some important things to be learned about aggregates. This is evident from the fact that the research laboratories of the country are devoting a considerable part of their efforts to studies of aggregates. The American Society for Testing Materials had on its 1929 program an extended symposium devoted to the subject of mineral aggregates.[2]

Recognizing the importance of composition in its relation to durability, much has been accomplished in the field of mineralogical and geological studies of aggregate materials.

The recent renewed impetus given to the use of artificial light-weight aggregates has brought problems in its wake that are being tackled and solved. When cement and water sink and the aggregate rises the usual situation in concrete mixing has been reversed. Such a mixture calls for a re-study of mixing and placing technique, and such studies are being made.

3. The Expansion of the Field

The field of concrete aggregates has undergone the kind of expansion that inevitably accompanies improved technique and better handling. Beyond this secondary expansion there have been no recent outstanding developments such as those which would accompany the discovery of a new field or outlet for concrete construction. On the other hand there are no indications that the field has been narrowed by inroads from competing materials. There is some tendency toward an extension of the field by using much higher strength mixtures than heretofore. Longer arch spans, for example, would be economically feasible if 6,000 or 8,000-lb concrete were to supersede 2,000 to 4,000-lb. concrete in such structures. The strength, durability and stiffness of the aggregate takes on added importance when used in stronger concretes. The question of the nature of the aggregate surface as it affects the bond with the cement paste may prove to be more important than it has been considered to be in the mixtures heretofore used.

In conclusion, it may be said, with special reference to the year just passed, that the aggregates industry has witnessed a sane and non-spectacular advance in the use and better understanding of these materials. The advances made in the last twelve months do not differ materially from those predicted by informed observers. There is no indication that the future trend will depart materially or abruptly from that of the past year. The interest in aggregates will probably be sustained because of economic considerations and the more exacting requirements for the mixtures that will be used. More definite standards for rating aggregates and judging deposits are needed. Basic studies of a much more fundamental type than have been made heretofore must soon be launched[3] if knowledge of aggregates and aggregate action in concrete is to keep ahead of practical requirements.

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[2] *Proc.* A. S. T. M. 1929 Part II, 740-901.

[3] Some such studies are outlined in: *Proc.* Amer. Soc. Test. Mat. 1929, Part II, pp. 853-861 and pp. 899-901, *Proc.* Amer. Concr. Inst. 1927, pp. 381-385.

Further Opinion on Steel Beams Encased in Concrete

The increased strength of steel beams and girders due to encasement in concrete, and the failure of American structural designers to take this greater strength into account, was discussed in an article by P. W. Leisner on Page 29 of the February (1930) issue of CONCRETE. The following letter from B. M. Lockard is of further interest in connection with this important subject.

Mr. Lockard's letter follows:

> Mr. Leisner's article on "Strength of Steel Beams Encased in Concrete," on Page 29 of your February issue, was very instructive. For many years I have been in search of just such information and have felt that concrete encasement should be taken in consideration as taking a part of the load when designing this type of structure.
>
> I hope Mr. Leisner's article will give courage to American engineers, who are woefully weak in taking the initiative in working up new designs, especially when there is a combination of two or more materials of different natures.
>
> B. M. LOCKARD
> Western Contracting Company.
> Chicago, March 19, 1930.

McGuire Joins National Sand and Gravel Association

D. D. McGuire, engineer of tests for the Tennessee State Highway department, has been appointed district engineer for the National Sand and Gravel Association, with offices in the Paul Brown Building, St. Louis.

During his work with the Tennessee State Highway department, Mr. McGuire was actively identified with a series of tests to develop proper methods of curing concrete pavements, and with the development of a pycnometer for the measurement of free moisture in aggregates.

Simplified Specifications for Quality Controlled Structural Concrete

For Insertion in Architects' General Specifications at Point Where Structural Concrete Work Is Covered

A SHORT form of quality-control specifications for structural concrete, suitable for inclusion as a part of a general specification at the point where concrete work is covered, is printed below.

These specifications, which were announced on page 18 of the April issue of CONCRETE, cover all essential points in sufficient detail for all practical purposes. They were prepared for the use of a firm of architects and structural engineers by several men who are considered authorities on the water-cement ratio method of controlling the strength and other qualities of concrete. The specifications follow:

Unit of Measure. The unit of measure shall be the cubic foot. Ninety-four pounds of cement (one sack or ¼ bbl.) shall be considered as one cubic foot. The unit of measure for water shall be the U. S. Gallon (231 cu. in.).

Measurement of Materials. The measurement of the component materials shall be such as to give the equivalent of the specified quantities in each batch and insure uniformity in successive batches. Free moisture carried by the aggregate shall be considered as part of the mixing water and the methods of measurement shall be such that this can be determined readily and the water to be added to the batch adjusted accordingly.

In measurement of aggregates, unless inundated or weighed, the materials shall be loosely thrown or sifted into the measure and struck off, the quantities being adjusted as required above to give the correct equivalent in dry materials of the quantities specified. The contractor shall provide equipment and make the tests necessary to determine the amount of this adjustment. The contractor shall also make tests to determine the amount of free moisture carried by the aggregates and adjust the quantity of water added so that the water-cement ratio shall not exceed the value specified.

Quality of Materials. The cement used shall be portland cement conforming to the Standard Specifications and Tests for Portland Cement adopted by the American Society for Testing Materials (serial designation C9-26).*

The fine aggregate shall be ____________________

(Insert here the description of both the fine and coarse aggregates intended to be used.)

Proportions and Consistency. Concrete for the various parts of the structure shall be mixed in the proportions specified in *Table I—Proportions for Concrete.*

These proportions have been selected on the basis of average aggregates meeting the requirements of these specifications, and to give a workability for the specified water-cement ratios which is suitable for the different parts of the structure. Should the aggregates used not give the desired workability when mixed in these proportions and with these water-cement ratios, the aggregate proportions may be changed within the limits of *Table II—Limiting Proportions of Fine and Coarse Aggregate,* provided that the slumps fall within the limits specified and that the mixtures are at all times such that they can be puddled freely into the angles and corners of the forms and around the reinforcement, and provided also that the mixture is not too harsh and does not cause segregation or the accumulation of water or laitance on the surface or the production of honeycomb in the mass. In no case shall the water-cement ratios specified be exceeded, unless ordered by the architect or the engineer in charge of supervision.

TABLE II

Limiting Proportions of Fine and Coarse Aggregate

Maximum size of coarse aggregate, in inches	Ratio of coarse to fine on basis of dry rodded volumes	
	Minimum	Maximum
⅜	0.4	0.8
¾	0.7	1.5
1 and over	1.0	2.0

Changes in proportions made necessary by the use of aggregates of grading or type other than those specified under "Quality of Materials" shall be made at the contractor's own expense, and no claim of any kind for extra compensation arising from such changes shall be honored.

Changes in proportion ordered by the architect or the engineer in charge of supervision, or changes in quantities resulting from changes in water-cement ratio, when ordered by the architect or the engineer in charge of supervision, shall be compensated for under the clauses in the contract covering extras and credits.

Mixing. Concrete shall be mixed in a batch mixer. The mixing shall continue for at least one minute after all ingredients are in the mixer and until the mass is uniform in color, and homogeneous.

Transporting. Concrete shall be handled from the mixer to the place of final deposit by methods which will prevent the separation or loss of the ingredients. Concrete that has partially hardened shall not be placed in the forms.

Placing. Concrete shall be thoroughly compacted by vibrating or puddling with suitable tools during the placing, and thoroughly worked around the reinforcement and embedded fixtures, and into the corners of the forms. Concreting shall be carried on as a continuous operation until the section or panel being placed is completed.

Curing. Exposed surfaces of concrete shall be kept continuously moist for a period of at least 7 days after the concrete is deposited.

Tests. The engineer in charge of supervision will make frequent strength tests during the progress of the work to determine whether the concrete is of the quality required. It shall be the duty of the contractor to maintain the correct water-cement ratio and consistency and he shall provide his own means for these tests. The record of these tests shall be at all times open to the engineer in charge of supervision and the facilities for making the tests shall be made available to him for such check tests as he may desire to make.

(End of specifications)

Note (a). The specification writer must insert in *Table I—Proportions for Concrete* the water-cement ratio and

TABLE I—PROPORTIONS FOR CONCRETE
(See Note *a*)

Part of Structure	Water-cement ratio in U. S. gal. per 94-lb. sack of cement	Approximate Proportions			Limiting slump in inches		Assumed Strength of concrete at 28 days as basis for design, lb. per sq. in.
		Cement, sacks of 94 lbs.	Aggregate				
			Fine, cu. ft. dry rodded	Coarse, cu. ft. loose	Min.	Max.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Footings							
Beams, Girders, Slabs					See Note c		
Columns							See Note b

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*If high early strength portland cement is to be used, change this reference to the A. S. T. M. Tentative Specifications and Tests for High Early Strength Portland Cement (serial designation C74-30T).

proportions for the various parts of the structure or various classes of concrete. These should preferably be determined by the engineer in charge of supervision by tests of available aggregates, cement and water, in advance of use. Where this is impracticable the water-cement ratio may be determined from *Table III—Assumed Strengths.*

TABLE III

Assumed Strengths

Desired strength of concrete in compression at age of 28 days, in lb. per sq. in.	Water-cement ratio in U. S. gallons of water per 94-lb. sack of cement
3000	6
2500	6¾
2000	7½
1500	8¼

In the absence of tests the approximate proportions of fine and coarse aggregate may be selected from previous experience with materials available in the local market. See also Appendix No. 16 of the Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

When strengths to be specified are higher than indicated in Table III, the water-cement ratio and mixing proportions shall be determined by advance tests. A curve representing the relation between the average 28-day strength of the concrete and the water-cement ratio shall be established for a range of values including the strengths to be specified. The tests shall include at least four specimens for each water-cement ratio. The water-cement ratio to be used in the structure shall be that corresponding to a point on the curve established by these tests representing a strength of concrete 15 per cent higher than the minimum ultimate strength specified.

For concrete work within the jurisdiction of a city building code account must be taken of the requirements of the code with respect to proportions of fine and coarse aggregates. It may be assumed that the city building department will approve any proportions between fine and coarse aggregates in which the sum of the separate volumes does not exceed the sum of the separate volumes specified in the code. Corrections should be made in the quantities of fine aggregate to take account of the bulking effect of moisture. The bulking, or swelling, of fine aggregate due to contained moisture, and the method of placing it in the measure, may result in a reduction of 25 per cent in the actual quantity of fine aggregate, as compared with that obtained by dry measurement by the standard method.

Note (*b*). Strengths of concrete to be used as the basis for designs should be inserted in the last column in *Table I—Proportions for Concrete,* by the specification writer.

Note (*c*). The specification writer must insert in *Table I—Proportions for Concrete* the minimum and maximum slumps which will be permitted for the different parts of the structure. The values in *Table IV—Limiting Values of Slump,* are recommended for various uses in order to avoid consistencies which are unnecessarily wet or too stiff for proper placement.

TABLE IV

Limiting Values of Slump

Class of Concrete or Part of Structure	Slump in Inches	
	Minimum	Maximum
Caissons, heavy foundations, massive walls	1	4
Pavements, floor slabs on the ground	1	4
Ordinary building walls, reinforced	3	6
Slabs, beams, girders	4	7
Thin walls, columns	4	8

New Books and Pamphlets

A. S. T. M. Proceedings

Proceedings of the American Society for Testing Materials, Philadelphia, Pa., Vol. 29, 1929. In two parts. Published by the society. Each part, paper cover $6.00; cloth $6.50; half-leather $8.00.

Part I (921 pages) contains the annual reports of 43 standing and research committees and five sectional and joint committees of the society. They include reports of Committees on Ferrous Metals and Alloys, Boiler Feed Water Studies, Cement, Concrete, Fire Tests of Materials, Preservative Coatings, Road Materials, Waterproofing Materials, Methods of Testing, 49 tentative standards which have either been revised or are published for the first time.

Part II (1,016 pages) contains 56 technical papers with discussions. These contain a symposium on mineral aggregates, and valuable information on results of investigations by experts in the field of engineering materials. Mention should also be made of the many papers on cement and concrete and a number of papers of interest in connection with the testing of materials, describing new testing apparatus.

Navy Concrete Design

Standards of Design for Concrete. By Lieut. Commander Ben Moreell, Civil Engineer Corps, U. S. Navy. Published by the United States Navy Department, Bureau of Yards and Docks. Paper cover, 216 pages, 6 by 9 in.

This handbook replaces a similar publication first issued in 1924. It is a general handbook of reinforced concrete building design, and contains an appendix covering various special subjects, such as influence lines, and moment and shear diagrams for continuous beams and continuous building frames.

The standard requirements for concrete classify this material into five grades, designated as Class A to Class E inclusive, and for which the 28-day ultimate crushing strengths are assumed at 1,000, 1,500, 2,000, 2,500 and 3,000 lbs. per sq. in., respectively. Working stresses in the concrete are about the same as in the American Concrete Institute regulations for the range of ultimate strength covered. The working stress for reinforcing steel, however, is limited to 18,000 lbs. per sq. in. for billet steel of intermediate or hard grade, for rail steel bars and for cold-drawn steel wire, and 16,000 lbs. for the structural grade of billet steel. These figures are 2,000 lbs. per sq. in. below those sanctioned by the American Concrete Institute.

Trade Practice Conference Handbook

Handbook of The Trade Practice Conference of the Reinforcing Steel Fabricating and Distributing Industry. Prepared by Butler, Lamb, Foster & Pope, general counsel, Chicago. Paper cover, 6 by 9 inches, 55 pages.

This handbook contains the rules established as fair trade practice by the conference mentioned in the title, with the approval of the Federal Trade Commission. This is followed by a description of federal trade practice conferences and what they may be expected to accomplish. Next comes a Digest of General Trade Practice Conference Rules, covering many hundreds of points on which rules have been established by the Federal Trade Commission.

~ EDITORIAL ~

The Construction Industry to Find Itself

THE first census of the construction industry to be undertaken by the United States Government is now under way.

The construction census is being conducted by mail, the blank forms being sent directly to individual contractors and sub-contractors. Replies are required by Act of Congress from all contractors whose gross business exceeded $25,000 during 1929; but the act specifically provides that the information obtained must be held in strict confidence by the census bureau. Only the consolidated figures can be given out. The reports cannot be used as a basis for taxation.

The information called for on the blank forms includes the number of salaried employees and total salaries paid; the number of skilled and unskilled workmen employed on a normal working day during each month; total wages paid during the year; working days per week; time lost due to strikes, lockouts and accidents; equipment investment and cost of rented equipment; payments for rent, interest, bond premiums, compensation and liability insurance; class of work generally performed; the value of general contract and sub-contract work performed; quantities and kinds of various building materials used.

The benefit of this construction census lies in the classified information which the consolidated data will divulge. Contractors may compare their own overhead costs with the average. Manufacturers of equipment and building materials will gain information as to location and size of prospective markets.

Contractors are urged to answer all the questions to the best of their ability, not because they are required by law to do so, but because the value of the census to the contractors themselves will depend directly upon the accuracy and completeness of the information received by the census bureau.

Planning and Detailing Concrete Form Work

NO contractor would undertake the construction of a reinforced concrete building without complete working plans; but such an attempt would be no more illogical than to erect the concrete form work for that building without working details.

This fact is emphasized by A. B. MacMillan in his article in this issue on "How to Save in Concrete Form Work." Mr. MacMillan's comments are addressed especially to builders who work on a comparatively small scale and have no draftsmen in their employ, and who may raise the objection that form work plans and details are an unnecessary expense.

By far the most common cause of waste in form work is the absence of detailed drawings and layouts. There is much waste of material and much time lost in re-cutting and re-fitting form lumber that was cut to the wrong dimensions, and in looking for lumber lengths and sizes wanted.

A man who is familiar with form erection and is able to lay out the work and detail it can be found. If he is employed elsewhere, he can usually be obtained to do such work at night. Blueprints can then be given to the form carpenter foreman and to the man responsible for ordering form lumber. While the preparation of these details will involve some expense, the contractor will get it back several times over because of the form lumber saved, the greater salvage value of the lumber that is used, and the very considerable reduction in labor costs on form work.

Splitting the Business Fifty Ways

IN and around a large city where about 25,000,000 concrete building units were sold in 1929, there are fifty concrete products manufacturers who split the business fifty ways.

The division of business was not in equal parts, to be sure, for more than half the plants are small concerns. The grievous part of the story is that some of these small proprietors don't know their manufacturing costs, for they are establishing heart-breaking price levels for the entire city by offering concrete building units at less than their real cost—at a price little above the cost of material and factory labor.

But things are happening in the products industry of that city. Out of the fifty, some five or six are slowly but surely emerging. These plants are managed by men who know the advantages of large-scale production and labor-saving equipment. They have installed, or soon will install, sturdier and more dependable block-making machinery, mainly automatic in operation. Material-handling equipment is taking the place of cruder and more expensive hand labor methods. Regularly organized sales forces are building up confidence in these products.

Gradually these five or six well-managed plants are getting the business, even at prices several cents above the prices of the little fellows. If this smaller but more able group follows up its advantage through co-operative advertising campaigns and selling methods and further scaling down of production costs, the future products business in that city will not be split fifty different ways.

This may be the cure for the ills of the industry in other cities—closer co-operation between a small group of well-managed and well-equipped concerns.

Current Activities of Organized Groups

Many knotty problems pertaining to cement and concrete are either in course of solution or recently completed by organized societies or smaller groups. The busy reader may keep himself informed by watching these items.

Consider Organization of Ready-Mixed Concrete Companies

A COMMITTEE appointed during the Memphis convention of the National Sand and Gravel Association is considering the feasibility of forming a division of the association which would devote itself to the problems of distributing ready-mixed concrete. It is suggested that in this manner the ready-mixed concrete industry may become organized at the lowest possible cost and at the same time be in a position to take advantage of the engineering and research facilities of the association. The committee is scheduled to make a progress report at the semi-annual meeting of the board of directors of the association, to be held in Milwaukee on May 14th and 15th.

Committee C-10 to Prepare Specifications for Building Units

THE LACK of American Society for Testing Materials specifications covering concrete building units has long been felt, more especially in the preparation of city building regulations.

Committee C-10 on Hollow Masonry Building Units is now expanding its scope to include standard specifications for concrete masonry building units. The membership of the committee has been increased by the addition of producers and users of such units. At a meeting held in Washington on April 3rd the new sub-committee on concrete building units presented for full committee discussion several tentative standards covering load bearing units, non-load bearing units, and definitions of terms.

Load Tests on Reinforced Concrete Columns

SOME PROGRESS has been made during the past year on the column tests undertaken by the American Concrete Institute in an effort to clear up the differences of opinion regarding the merits of various formulas for the design of reinforced concrete columns.

Most of the controversy has been centered around formulas for spirally reinforced concrete columns. A comparison of city building codes disclosed great variations in such column formulas, some cities permitting safe loads almost twice as much as others, on a column of identical cross-section.

A committee of the Institute is now engaged in raising funds to cover the expense of the tests, so that the work may be carried forward unhampered by want of financial support.

Specifications for Plastering

A COMMITTEE on specifications for plastering has been organized under the joint sponsorship of the American Society for Testing Materials and the American Institute of Architects. The chairman of the committee is Arthur O. Lynas, of Dwight P. Robinson & Co., of New York.

Four sub-committees have been appointed, one on cement plastering, one on gypsum plastering, a third on lime plastering, and a fourth on metal lath and plaster.

These sub-committees have been instructed to have their reports available not later than July 1st, in the hope that complete specifications may be available by September 1, 1930.

A. S. T. M. Establishes Cement Testing Reference Laboratory at Bureau of Standards

THE CEMENT Testing Reference Laboratory recently established at the U. S. Bureau of Standards, Washington, D. C., is doing effective work in calibrating cement testing equipment, and in giving instruction to those engaged in such tests. At the present time three field inspectors are giving practically all of their time to the visiting of testing laboratories all over the United States. Two of the field inspectors are working in the East and one on the Pacific Coast.

Marking Billet Steel Reinforcement for Identification

THE CONCRETE Reinforcing Steel Institute, whose membership is comprised of the fabricators of reinforcing steel throughout the country, has during the past year perfected a system of marking new billet reinforcing steel so that the mill source can be identified by the purchaser. All bars above the ¼-in. round size rolled at the principal mills manufacturing this kind of steel are marked with a raised letter once in each turn of the rolls (approximately every four feet). The identifying letter is rolled integrally with the bar and cannot be removed.

In general, the first letter of the name of the mill is the character used for identification. In the very few exceptions to this rule, the mill source indicated by the letter can be obtained from the distributor fabricating the reinforcing steel.

A. S. T. M. Studying Masonry Cements

AT A MEETING of the American Society for Testing Materials Committee C-1 on Cement, held in March, at the Book-Cadillac Hotel in Detroit in conjunction with the Spring Group Meetings, the committee gave considerable attention to masonry cements. The committee decided that a more detailed study of masonry cements, particularly in the development of tests to determine the workability, is desirable. The personnel of the committee is accordingly being increased to include the producers of these cements.

Merged Pipe Organization on Heavy Production Basis

New Los Angeles Plant of American Concrete Pipe Company Covers 38 Acres—Makes Pressure Pipe, Sewer Pipe, Electric Conduits, Drain Tile and Concrete Piles—Centrifugal Process Employed with Piles and Pressure Pipe—Units Cured in Steam 12 Hours—Company Has Branch Plants in Oakland, San Diego, Tacoma, Phoenix, Fort Worth, Dallas and Amarillo

By JAMES N. HATCH

THE American Concrete Pipe Company was formed in 1929 by the merging of the Western Concrete Pipe Company and the Bent Concrete Pipe Company. Their plant at Southgate, Los Angeles, California, which was completed some months ago, is one of the largest concrete manufacturing plants in the country. The buildings and storage yards cover 38 acres of land. This is the main plant of the company, but it has branch plants in operation in Oakland and San Diego, Calif., Tacoma, Wash., Phoenix, Ariz., and in Fort Worth, Dallas and Amarillo, Texas.

Products Manufactured

The company manufactures at this plant three distinct kinds of concrete pipe, (1) the ordinary sewer pipe without reinforcement, in sizes from 4 in. to 24 in. and 3 ft. long; (2) Hume centrifugally spun pipe, reinforced with wire, in sizes from 6 in. to 75 in. in diameter and 6 ft. to 8 ft. long; and (3) precast reinforced pipe from 12 in. to 90 in. in diameter and from 3 ft. to 6 ft. long. It also makes conduit for electric wires and has lately made centrifugally spun reinforced piles. Owing to the mild climate of California, most of the manufacturing is done in the open and the work is continuous throughout the year.

Raw Materials

The cement, crushed rock, and gravel and sand, are purchased from various producers of those materials in the nearby territory and are received by train. The company has switches from the Union Pacific and the Southern Pacific railroads. The stone and sand are dumped from the cars into a large steel lined receiving hopper beneath the track. From this hopper a bucket elevator carries the material up about 75 ft. above the track level and delivers it to a belt conveyor which distributes it into any of ten hoppers for storage. This belt conveyor may also be made to feed onto an 18-in. cross belt conveyor which transfers sand and stone over across the tracks to an auxiliary bunker situated over the Hume machine. The storage bins are made of timbers with steel bars tying them together. The main bunker consists of a concrete structure supporting the bins, and is arranged with storage space for several carloads of cement.

Plain Sewer Pipe

Directly beneath the auxiliary storage bins are outlet gates from which the proper proportion of sand and stone may be let out into two different concrete mixers, one feeding the sewer pipe machine and the other the Hume machine. The mixer for the sewer pipe machine mixes the materials in a so-called dry mix. This mealy dry material is then conveyed across to a Martin packer head machine and made into bell and spigot sewer pipe.

In the floor beneath the packer head machine is a small turn-table on which there are stands for two pipe forms which may be turned and alternately brought beneath the packer head. An iron ring to form the bell end of the pipe is placed on the turn-table and the steel pipe form set upon it and clamped down, while the other form is being filled. As soon as this is completed the turn-table is rotated, bringing the filled form out and the empty form under the packer.

Concrete mixer for Hume machine. Trunnions for large pipe in foreground. Belt conveyor shown at ceiling can be lowered to floor for delivering concrete to forms

When the form is centered under the packer, the packer head, which is revolving rapidly, is lowered into the bottom of the form and the concrete is raked into the form from a chute over the machine. The revolving head is slowly raised through the form, compacting the concrete under considerable pressure against the form. When this has reached the top and has been removed the pipe is complete and is turned out from under the packer. It is then picked up by a two-wheeled buggy and taken to the steam room. The time to form a pipe is about thirty seconds.

When the pipe is placed on the floor in the steam room, the form is unclamped and sprung open and removed. The pipe is left on the floor standing on end, for curing. There are three steam rooms used alternately. When a room is filled it is closed tight and a wet steam is turned on. The pipe is left in this room for twelve hours and then piled out in the yard and kept wet by sprinkling for seven to ten days, depending on the weather conditions.

Hume Centrifugal Pipe

Not far from the mixer for sewer pipe is another mixer for the Hume centrifugal machines. The concrete made in this mixer is wet and is discharged from the mixer into 4-wheel skips and pushed over to the pipe-spinning machines. The sections of Hume pipe are centrifugally produced on a machine with four spinning units making three pipes at one time. There are three of the spinning units for different sizes of pipes, and each one can be adjusted to make several sizes. The sizes run from 6 to 75 in. The form for an 84-in. pipe is now in the yard and will be used later. The machines are changed for producing different sizes of pipe by moving the runners or trunnions different distances apart on the bed.

Eighty-four inch precast pipe. A six-foot man is standing within it

The outer form for the pipe is made up of a cylindrical steel jacket. There are three or more jackets for each machine, placed horizontally on runner wheels or trunnions which rotate at different speeds, as the forming of the pipe progresses. Within the jacket is placed a single cage reinforcing web of steel wire. This cage is cylindrical in form, conforming to the inner circumference of the jacket to which the cage is anchored. The diameter of the cage is such as to bring it into the proper position in the concrete pipe. The centrifugal force of the revolving jacket causes the reinforcing cage to assume its position symmetrically within the concrete.

Three or more sizes of jackets are operated on each machine. The first of these machines is used for pipes from 8 to 12 in. in diameter and 6 ft. long. The other two machines are for pipes from 14 to 75 in. in diameter and 8 ft. long.

When the jackets with the wire cages in place are ready to spin the motor is started and the forms turn at comparatively slow speed. One man at each end of the pipes shovels the mixed concrete from the skips into the forms. Enough concrete is put in to make a pipe of the proper thickness. The centrifugal force of the revolving form immediately works the concrete in against the form and behind the wire cage and spreads it to a uniform thickness throughout the length of the pipe. When the concrete has adjusted itself evenly inside the form and is smoothed down into the reinforcing cage, the cylinder is spun at a higher speed for eight to fifteen minutes. The heavier conglomerate is compacted against the form and the lighter material, such as bits of wood, laitance or foreign particles and surplus water is crowded out upon the inner surface of the pipe. After a few minutes of rapid rotation the machine is stopped and the surplus water and other foreign materials are swabbed out. A large percentage of the original mixing water is thus removed. The expelled water and laitance, or slurry, contains practically no cement and has no setting quality. The pipe is then respun for a few minutes and a smooth interior surface is produced by the two men holding a long burnishing rod made of polished pipe against the inside of the pipe as it spins. The speed of the revolving pipe is then increased to the maximum, this maximum speed varying with different pipes and different aggregates, and so continued till the process is complete. When the pipe is finished it is so compact that it cannot be indented by the thumb. The interior is found to have an extremely hard polished surface similar to that of a well finished sidewalk.

Removing forms from sewer pipe. The form is removed immediately upon reaching the yard

Calking collar on bell end of centrifugally spun pipe

After the spinning is completed the pipe, still in the forms, is moved to a steam room and there allowed to remain for twelve hours in a warm, saturated atmosphere of about 90 deg. F. After leaving the steam room the pipes are stripped of the forms and put out in the yard, where they are kept wet for six or more days by sprinkling.

Joints

The pipes as they come from the forms are straight cylinders with tongue-and-groove ends. In order to make bell-and-spigot pipes of them it is necessary to fit one end of each pipe with a collar. The collars are reinforced and are made by the centrifugal process, but the jackets for making collars are equipped on the inside with a series of circular separating rings of a spacing equal to the length of each collar—that is, 7½ in. The jacket thus fitted is filled and spun in a manner similar to that just described. Twelve collars are formed in one operation.

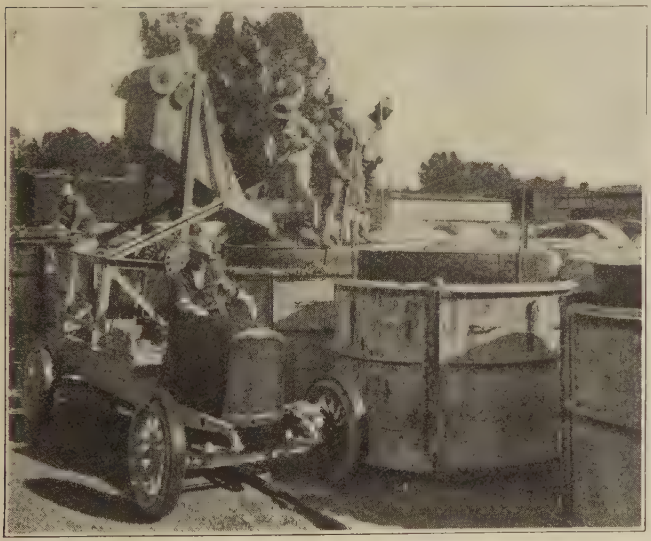
The collars are of a size that leaves ¾ of an inch between the collar and the outside of the pipe, which space is filled with neat moist cement and calked in. Provision for expansion and contraction may be made by filling in with elastic cement.

Piles

The manufacture of concrete piles by the Hume process has been carried out in a limited way during the past year, with much promise of success. Piles 16 in. in diameter and 35 ft. long with spiral reinforcement and with eight ¾ in. longitudinal reinforcing bars have been made and are being used. These are made in a manner similar to that used in making pipes except that a series of intermediate trunnions are required at about 8-ft. intervals instead of only at the ends. The pile has a hollow core, the size of which is determined by the amount of water expelled. The piles may be driven or jetted into place.

Poured Reinforced Pipe

On the west side of the main storage bunkers there are mounted three 4-bag concrete mixers, just under the spouts of the material storage bins and about ten feet above the ground. The mixers supply concrete for the precast reinforced pipe which is manufactured in the open field west of the bunkers. The cement and aggregates are fed into the mixers by conveyors and the mixed concrete is taken from the mixers to the forms several hundred feet away in a specially devised motor dumping truck. The pipes made here have tongue-and-groove ends and range in size from 12 to 102 in. in diameter and from 3 to 6 ft. long.



Concreting and tamping precast pipe. Note pipe that is seasoning is covered with canvas to prevent too rapid drying

For making poured or precast pipe, the steel rings to form the bell are laid on the ground and the steel form for forming the inner surface of the pipe is set up in sections and clamped together. The outer form is then set up and clamped together and the reinforcing cage, which has been made up on the ground nearby, is dropped into the space between the forms and lined up by vertical spacers to keep the reinforcement in proper position. The surfaces of the forms are sprayed with oil to keep the concrete from sticking. In the larger pipes the reinforcing cage is elliptical in form and is lined up with spacers to get this result. The concrete is fed into the forms from the dumping truck, which is arranged to dump the concrete from a height of as much as seven feet above the ground. The concrete is tamped in between the reinforcement with thin steel tampers. The forms are kept on for one day, when they are stripped off and the pipes kept wet for seven days.

Warehouse, storeroom, machine shop and plate shop

Loading and Shipping

The sewer pipes are piled by hand in piles five or six feet high and are loaded by hand into motor trucks. The Hume pipe is stored on wood runways which extend across the entire storage yard. The runways are equipped with several transfer tables for distributing the pipe over the yard, as may be required. Pipes that are to be shipped out are rolled down the runways to the east end of the yard and loaded upon trucks at a loading point. The very heavy pipes, especially the precast pipes, are handled by a truck crane or crawler crane. The company is provided with seven of these cranes of different types. The delivery of pipe is made on heavy six-wheel trucks with trailers.

Machine and Plate Shop; Garage

A large machine shop and plate shop is operated by the company where most of the operating equipment is fabricated. The shop is equipped with boring mills, lathes, draw shaper, milling machine, planer and auxiliary machinery. The plate shop is provided with shears, rolls, electric welding machine, and minor equipment.

A completely equipped garage is maintained for the repair and maintainance of the large fleet of motor trucks and other motor operated equipment used by the company.

An entirely separate department is operated for experimental and research work. A complete testing laboratory is maintained where chemical and physical tests are made to determine the quality of materials and the effect of various combinations. This department has its own concrete mixers, forms, and other equipment for making all sorts of tests.

Precast Concrete Caissons *for Piers and Docks* Floated Into Place

Huge Precast Caissons Are Floated by Unique Methods and Towed Into Place—Cost Reduced and Time Saved—Vast Amount of Concrete Work in New Polish Harbor at Gdynia

By P. W. LEISNER
Consulting Engineer, Chicago, Ill.

A NEW method in harbor construction, successfully used in the building of the now completed first portion of the Polish harbor at Gdynia,* should be of interest to American builders. The method has all the characteristics of successful mass production.

The site of this harbor is entirely within Polish territory, about six miles from Danzig. The new city of Gdynia, which is being built concurrently with the harbor, was a little fishing village of about 200 population in 1924, when the construction of the harbor was decided upon.

The story of Gdynia harbor begins in Washington, D. C., when President Woodrow Wilson, in addressing Congress on January 8, 1918, included Poland in the thirteenth of his famous Fourteen Points, suggesting that there should be created a free and independent Poland having free and secure access to the sea.

Mr. Wilson's idea was duly worked out in the peace conferences, and resulted in the creation of Poland, including the Polish Corridor, a tapered strip of land extending from the main part of Poland to the Baltic Sea.

The Corridor has a frontage of about 37 miles on the shore of the Baltic, immediately adjacent to the city of Danzig, which was made a free and independent city by the peace conventions. Danzig has an excellent harbor, in which Poland was given certain economic rights.

Own Seaport Needed

The conflict between Poland and Russia in 1920 proved that the Polish rights in the Danzig harbor were not sufficient to serve all Polish requirements. Plans were then prepared by the Polish engineer Wenda for the harbor at Gdynia. The plans were finally adopted by the Polish government on July 4, 1924, when a contract for construction was awarded to Le Consortium Franco-Polonais pour la Construction du Port de Gdynia (the French-Polish Company for the Construction of Gdynia harbor). Associated with these general contractors were the Belgian firm Ackerman & Van Haaren, who did all dredging, and the Danish firm Hojgaard & Schultz, who constructed the breakwaters, piers and docks.

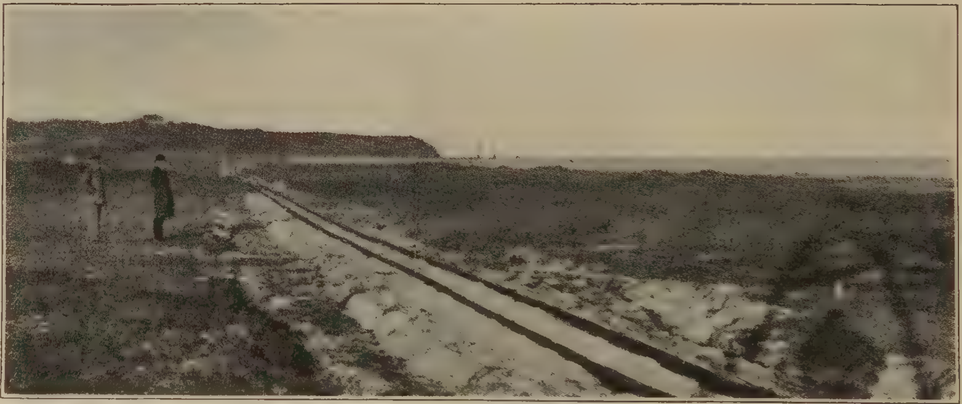


Figure 1. Flat, sandy marsh was original site of Gdynia Harbor

Once the construction of the harbor was authorized and contracts were awarded, subsequent developments are described as having progressed with "almost American speed." The plans for the harbor, as previously stated, included preparations for a city of 60,000 inhabitants.

A Village Becomes a City

Shores near the little fishing village which were swamp in 1924 now have a complete sewer system, water works, electricity and fire stations. A railroad station, admin-

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*Pronounced Gedynia.

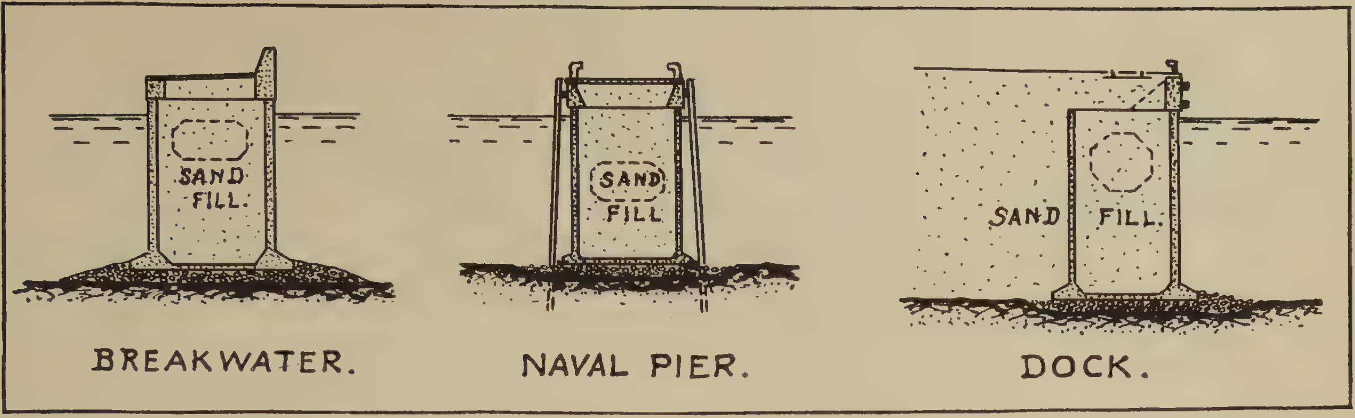


Figure 2. Typical cross-sections of the breakwater, piers and docks, showing concrete caissons in final position

istration buildings, a school and many other public buildings, as well as numerous private dwellings, hotels, business houses, warehouses, gantry cranes, etc., have "sprung out of the ground, American fashion."

The construction of breakwaters, piers and docks is of special interest to builders. The method is entirely new and is covered by patent.

400 Huge Concrete Caissons Floated Into Place

About four and a half linear miles of reinforced concrete floating caissons, rectangular in plan, were used in the construction. The caissons were towed to their positions in the harbor, where they were sunk to rest on a prepared sand and gravel foundation and given stability by being filled with sand. Typical cross-sections of the breakwater, piers and docks are illustrated in Figure 2.

The largest caissons were 105 ft. long, 23 ft. wide and 35 ft. deep, divided into nine cells by vertical cross walls. The width of the bottom, or base, was 30 ft. The weight was about 1200 long tons. Most of the caissons were made a standard length of sixty feet, divided into five cells by vertical cross walls.

Caissons Right Themselves to Floating Position

Instead of following the usual practice of building these caissons in dry dock or on launching ways, the contractors decided to build them upon the surface of land which was to be dredged out for the harbor basins. The caissons

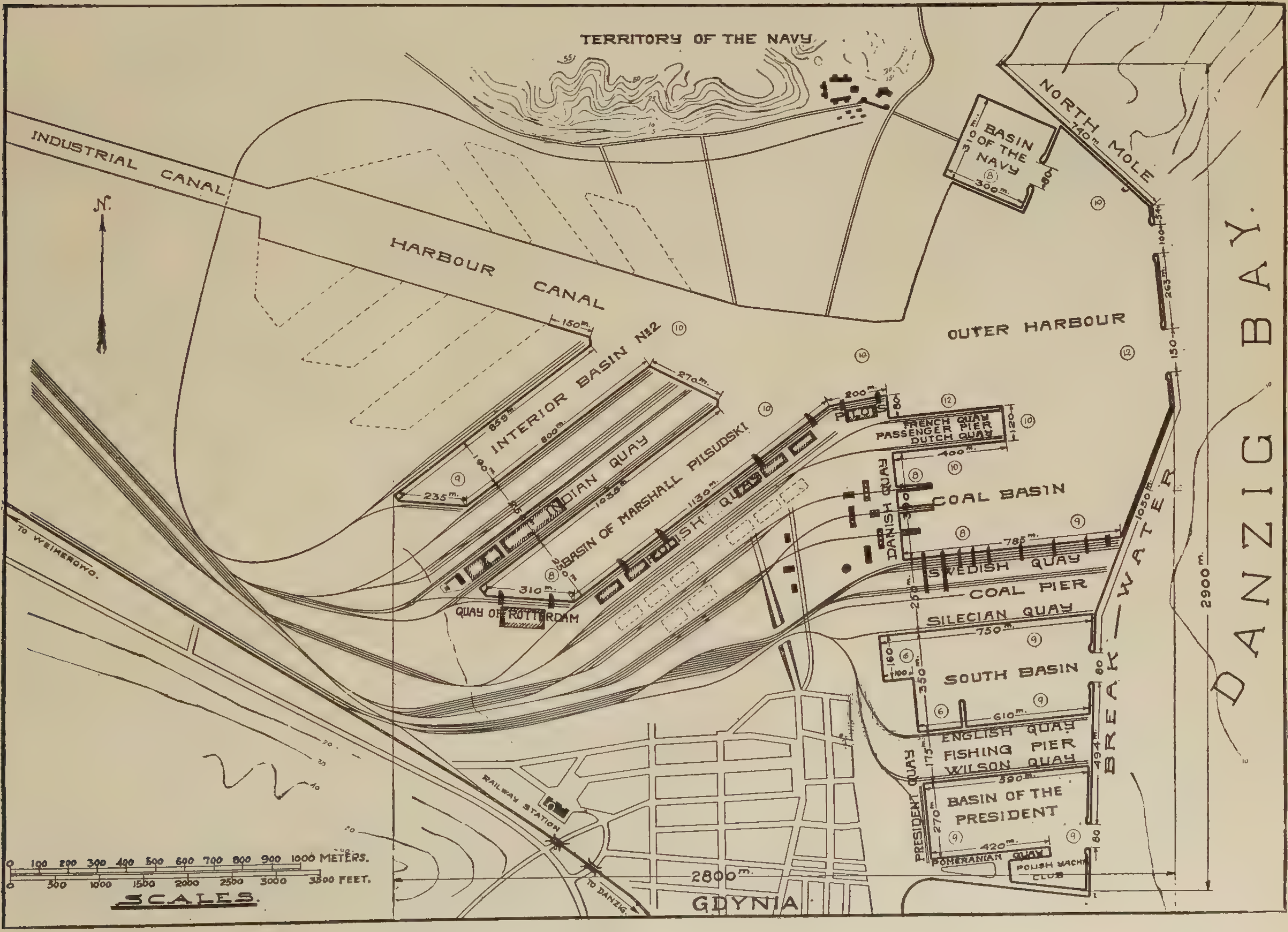


Figure 3. Layout of Gdynia Harbor, the new Polish sea port

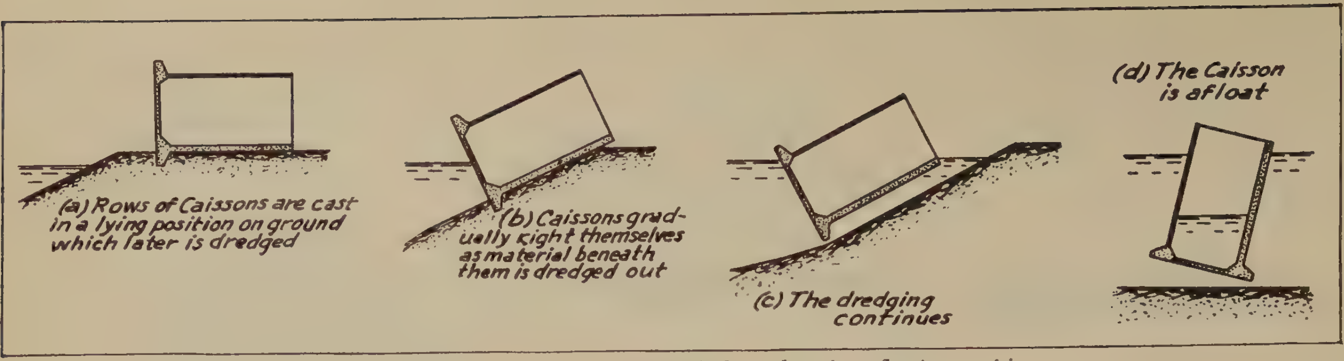

(a) Rows of Caissons are cast in a lying position on ground which later is dredged
(b) Caissons gradually right themselves as material beneath them is dredged out
(c) The dredging continues
(d) The Caisson is afloat

Figure 4. Showing how caissons righted themselves into floating position

were cast in a lying position on the ground, in long rows, as shown in (a) in Figure 4. As dredging proceeded, the finished caissons gradually righted themselves on the advancing slope until they floated, as illustrated in (d) in Figure 4. The dredging was done with suction dredges.

The method, although new and untried, was adopted in the first place for the purpose of forcing the speed of construction. The work was completed without a single mishap to the more than 400 caissons in so short a time that the harbor was completed almost a year ahead of the date originally fixed by the contract.

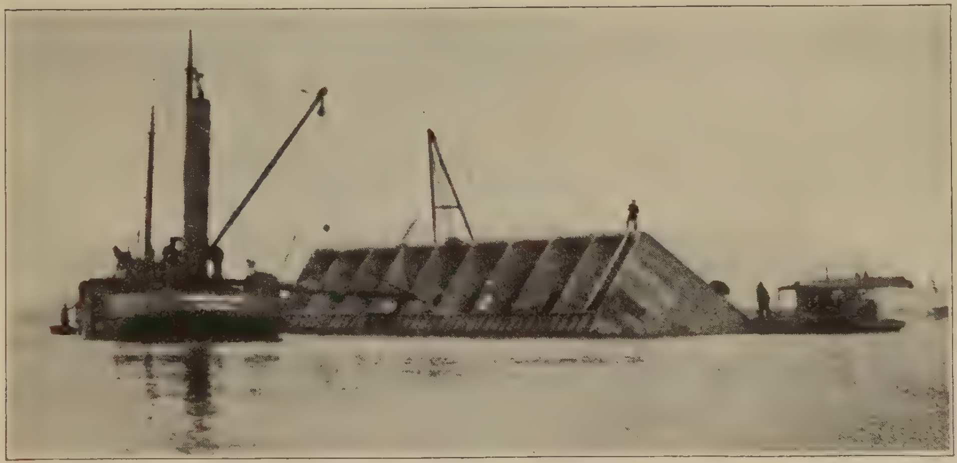


Figure 5. Towing the floating concrete caissons into position

Figure 1 shows the terrain at the time of commencement of construction, a flat, sandy marsh. In the extreme right of the illustration is seen the shadow of the tower which forms part of the concrete plant, which is mounted on flat cars. The plant has a tower with a horizontal crane runway for depositing concrete in the caisson forms.

Figure 2, as previously stated, shows cross-sections of caissons in their final position, filled with sand to give them stability. Figure 3 shows the complete layout of the harbor. Figure 4, previously described, shows how the caissons righted themselves into a floating position as the ground was gradually dredged out from under them.

In Figure 5 a large caisson of nine cells is shown floating in tow of a tug. Once the caisson is clear of shallow water, the tug pumps water into it until it floats with but a slight listing.

While cost data on this harbor construction would be of little value in this country, the writer is informed that this modern application of reinforced concrete to harbor structures has been found very economical quite apart from the economic advantage gained by greater speed in construction.

Descriptions and illustrations are based on drawings and other information supplied by K. Hojgaard, C. E., formerly connected with the Strauss Bascule Bridge Company, of Chicago.

Reinforcing Institute Holds Sixth Annual Meeting; Officers Re-elected

The opening session of the recent meeting of the Concrete Reinforcing Steel Institute included a forceful address on the subject "Co-operation in the Building Industry," by Col. Geo. B. Walbridge. The meeting, the sixth annual, was held at the Bon Air-Vanderbilt Hotel, Augusta, Georgia, March 31st to April 2nd.

A number of reports were presented by the chairmen of the various Institute committees, including those on grade of steel, concrete joist construction, engineering practice and standard practice.

C. Louis Meyer was elected president of the Institute for another year in conformity with the policy of the Institute to have each president serve for a term of two years. O. W. Irwin was re-elected vice-president of the Institute and Hugh J. Baker was re-elected as treasurer.

W. H. Pouch was re-elected as a director, to serve for a term of three years. E. B. Wilkinson was elected to represent the South as a director for a three-year period succeeding D. B. Knowlton, whose term expired.

M. A. Beeman of Chicago was re-elected as secretary for his sixth consecutive year. R. W. Johnson was reappointed as engineer, while J. P. Thompson will continue as district engineer for the eastern territory and Arthur Burnie will continue as district engineer for the Kansas City territory.

Good Practice in Concrete Floor Finish

Report of Committee 802 of the American Concrete Institute Recommends Drastic Changes from Prevalent Practice—Some Bad Practices That Make Poor Floors —Gives Procedure for Manipulating the Finish

THE assignment of this committee was to prepare a report on good practice in finishing portland cement concrete floors, with special reference to workmanship and the time, amount and kind of manipulation recommended for the final results.

In order to show clearly and properly emphasize the causes of difficulties of the past, and to outline the advantages of different procedure, it is necessary to review the methods that have been used in the past.

Poor concrete floors result more often from improper manipulation of materials than from the use of inferior materials.

The report of Committee 802 of the American Concrete Institute, prepared by John G. Ahlers, author-chairman, points out some bad practices that are too prevalent in the placing and finishing of the concrete floor topping. The procedure recommended is based on actual experience. Other parts of the committee report, including specifications for heavy-duty and "dusted-on" floor finish, will appear in the June and July issues of "Concrete."—The Editors.

Inferior floors are caused by:

Use of too much mixing water.

Too much manipulation (screeding, floating, troweling) of the wet mix, bringing fine particles and laitance to the surface.

Too high a percentage of fine particles (passing the fifty mesh) in the sand.

Improper curing.

Good floors can be produced by:

Limiting the mixing water from 4½ to 5 gallons per sack of cement, and increasing workability by longer mixing.

Using only coarse sand.

Using not less than 1½ parts of coarse aggregate.

Not floating or troweling the surface when it is wet and sloppy.

Delaying the finishing operation after screeding until all surface water has disappeared (from 30 to 45 minutes).

Proper curing for not less than 7 days.

The attitude of the contractor and his men is important.

Lack of interest by those responsible may give poor results when the best of materials are used. Costs need not then be increased by more work. It needs merely intelligent work. The stress needs to be on manipulation.

Comparison of Manipulations

First, let us consider the old 1:2 specification. The principal ingredients are cement, sand and water. As a rule, the sand used for floor topping is the same as that employed in the regular building operations. No account is taken of the effects of fine materials. Sand and cement are mixed with an amount of water that gives a consistency which will work well under the trowel. Mortar is placed on the base, struck off and floated. Troweling operations start almost immediately. Excessive troweling at this particular period is the one operation that produces the most unsatisfactory results in the surface.

When a steel trowel is applied to a soft mushy topping, water, cement and fine materials are immediately drawn to the surface, where they should not be. The fines assist in producing "a nice looking" finish, but they have little or no wear value. Troweling operations usually continue until the surface is stiff enough to produce a smooth, even finish composed largely of these fine particles.

Another bad practice extensively used is in dusting cement or cement and sand on the surface after the topping has been screeded, and before it has hardened.

There must be a new conception of toppings. Mortars, as generally understood, should not be employed. Essentially there are required definite proportions of cement, sand (graded somewhat coarser than normally used) and stone or gravel consisting of particles slightly larger than the maximum sized grains in the sand. The mixture should be placed and finished as described in another part of this report.

Curing the Floor Topping

The last operation in floor finish construction is that of curing. The value of proper curing has been established by all investigators of cement and concrete, and applies with greater force to floor finish than to any other form of concrete construction. If the usual specification for covering with damp sand is ignored, and the concrete permitted to dry at the surface before the chemical reaction between water and cement has progressed far enough, inferior floor finishes invariably result.

Condition of the Structural Slab

Whether the topping is placed independently and after the base has hardened, or monolithically with the base, the procedure normally followed is parallel to that just described. When placed monolithically with the base, the topping is usually mixed just at it would be for placing on a hardened base. If care is not exercised, excess water used in the concrete for the structural slab tends to increase the water-cement ratio of the mix for the finish as well as to incorporate in the surface all the fines and impurities that are on the top of the structural slab. Here again, excessive manipulation with a steel trowel will produce a defective floor finish. It is therefore recommended that where the topping is placed monolithically with the base, the structural concrete be placed as dry as possible and with the least possible water in the topping mixture. Excellent results may also be obtained by allowing the structural slab to harden for eight or ten hours, after which the topping is placed.

Recommendations

The committee presents for consideration a specification which not only embodies provision for the mixture of cement, water, fine and coarse aggregates, but also a procedure in operation. The mixture consists of 1 part of cement to 1 part of coarse grained sand which shall contain not to exceed 10 per cent of fines passing a 50 mesh screen, and 1½ to 2 parts of gravel or crushed stone ranging in size from ¼ to ⅜ in. To this shall be added 4½ to 5 gallons of water per 94-lb. sack of cement. Such a mixture will be somewhat harsh and unworkable when considered from the standpoint of structural concrete, or the old mortar top mixes. However, the method of placing and the manipulations necessary to produce a smooth hard finish are such that these proportions can be compacted and worked into the desired finish. Basically, the principle of producing workability is the same in this case as in structural concrete. There must be enough cement paste completely to surround the aggregate particles. The question, therefore, is one of mechanical operation in order to produce the desired finish.

Should Use Less Fine Aggregate

Floor finishes can be mixed with less fine aggregate than can structural concrete. There are two reasons for this requirement: First, it is desired to expose at the surface as much of the extremely hard coarse aggregate as is possible so that it will take most of the wear; second, in compacting the floor finish by rolling, troweling or otherwise to eliminate the tendency of the fine aggregate working to the surface. If there is an excess of fine material in the mixture, it will be difficult to keep the coarser particles at the surface.

Coarse Sand and Small Coarse Aggregate

It is recommended that the proportions for the floor topping mixture be designed for each specific job by the trial method. Trial batches in the proportion of 1 part of cement to 1 part of coarse grained sand and 2 parts of coarse aggregate graded from ¼ to ⅜ in. should be mixed with the specified amount of water. If it is found impossible to place this mix on the slab under the procedure outlined, a slight adjustment may be made in the volume of the coarse aggregate. The proportion of the coarse material may be adjusted down, but under no circumstances should the coarse aggregate be less than 1½ parts, nor the water increased above 5 gallons per sack of cement.

Procedure in Placing the Topping

After these proportions have been mixed for not less than 2 minutes, they should be placed on the structural slab and screeded into position. The topping is then floated, bringing to the top a small amount of mortar for finishing purposes. The floor is then allowed to stand for 30 to 45 minutes, depending upon weather conditions, before troweling operations start. In this time the topping will have stiffened sufficiently to prevent fine particles from being brought to the surface by troweling. Final troweling may then proceed without damaging the surface. The more hard troweling at this particular time, the denser will be the slab and the more coarse aggregate at the surface. Hard troweling has the effect of forcing the coarse particles of aggregate into the mass and covering them with just enough mortar to produce a smooth finish.

The mix and manipulations above specified will no doubt draw criticism from the mechanics. It will take more muscular effort to spread and screed such a mix than is required under the old specifications. There will also be criticism of the delayed finishing operation because the surface will become fairly hard and rather difficult to work with a trowel. If this practice is not followed, however, the old difficulty of bringing up too much fine material to the surface and the over-working of moist and wet spots will produce a floor with a high percentage of laitance and soft spots.

As soon as the concrete has hardened sufficiently to prevent pitting, it should be wetted down and covered with damp sand or a specially prepared paper that may be sealed to prevent evaporation. Where sand is used, it should be kept wet for not less than ten days.

Here are tabulated the total labor and material costs for a piece of floor placed under this specification a few days ago. It shows a net cost of slightly over seven cents per square foot, very much less than we thought would be the cost of this type of floor finish. The superintendent on this work was instructed to place this section of floor under this specification and was very reluctant to start as he was afraid he could not do a very satisfactory job with the water content so low.

	Area	Quantity	Total Cost		Sq. Ft. Cost
Cement	3500 sq. ft.	13.8 Bags	$69.00		$.02
Sand	3500 sq. ft.	6.8 Yds.	13.60		.004
Grit	3500 sq. ft.	6.8 Yds.	22.10		.0064
Cement Labor	3500 sq. ft.	10 men 3 hrs. 30 hrs. @ $1.17	35.10		.01
Cement Mason	3500 sq. ft.	43 hrs. @ $1.65 8½ hrs. @ $1.87½	71.85 15.95	87.80	.025
Overtime	Bonus	6 hrs. @ $1.65 1½ hrs. @ $1.87½	9.90 2.85	12.75	.0036
Labor Foreman	3500 sq. ft.	3 hrs. @ $1.50	4.50		.0013
			Total		$0.07

No allowance for tools, supplies, plant rental, power, field overhead or profit.

From personal inspection while the floor was placed, we found, however, that it was possible to mix the finish and place it with a water content of exactly five gallons per bag of cement. It is believed that one reason for such a low amount of water was the mixing of the topping for not less than two minutes; this gave a very plastic and workable material even with the large amount of grit. This item of time mixing should be further stressed in a specification.

On this particular work we happened to have two foremen working with their finishing tools and they both expressed their satisfaction with the mixture and the ability to handle it under the trowel. It is very important that the specification be such that practical men will live up to it, as otherwise it is quite useless.

Thirty-Third Annual Meeting of the A. S. T. M.

The thirty-third annual meeting of the American Society for Testing Materials is to be held at the Chalfonte and Haddon Hall hotels in Atlantic City, from June 23rd to 27th, inclusive.

The Committee on Papers is arranging a full and well balanced program. In view of the unusual number of valuable technical papers offered this year the committee has accepted a greater number than for any previous annual meeting. Because of this situation the papers have been definitely limited as to size and the authors have been requested to prepare condensed presentations.

Simultaneous sessions will again be held, since this plan has been found most satisfactory in previous years.

How to Save in Concrete Form Work

Necessity for Key Plans—Use of Key Plans—Erection of Supports—Provision for Permanent Shores—Setting Permanent Shores—Stripping the Forms

V—Forms for Floor Bays in Flat-Slab Construction

By A. B. MacMILLAN
Chief Engineer, Aberthaw Company, Boston, Mass.

THIS article will deal only with the form work for the floor slab part of flat-slab construction. The form work involved in connection with the drop panels around the column heads will be covered in the next article of this series.

The erection of form work for flat-slab floor bays can be described much better in drawings than in written descriptions. Figures 24 to 29, inclusive, tell the story in sufficient detail to enable the intelligent foreman on form work to understand them without reference to written descriptions, as we know from experience with our own construction crews.

Necessity for Key Plans

The use of the key plans shown in Figure 24 and Figure 25 requires further explanation here, since their use may be new to some builders of concrete structures.

The preparation of these key plans is work that usually falls to the lot of the contractor. The same is true of all form work details, inasmuch as form details are not considered as being a necessary part of the working plans furnished by the architect or structural engineer. At this point it will be well to insert a word of warning to contractors who may feel that they can get along without such plans and details. Builders who work on a comparatively small scale, and have no draftsman in their employ, will raise the objection that form work plans and details are an unnecessary expense. Here is where they are wrong. By far the most common cause of waste in form work is the absence of plans and details. One might as well attempt to erect a building without plans, for the result would be about the same. Without plans and details of form work, there will be much waste of material and much lost time in re-cutting and re-fitting forms that were cut to the wrong dimensions. Still more time will be lost in looking for lumber lengths and sizes wanted.

Except in very small and isolated communities a man can be found, most likely in the office of an architect, who is familiar with form erection and able to lay out the work and detail it. If he is employed elsewhere, get him to do the work for you at night. Blueprints can then be given to the form carpenter foreman and to the man responsible for ordering form lumber. While this will involve some expense to the contractor, he will get it all back (and several times over) because of the form lumber saved, the much greater salvage value of the lumber that is used, and the very considerable reduction in labor costs on form work.

How Key Plans Are Used

The key plans shown in Figure 24 and Figure 25 are nothing more than layouts of floor bays with the floor form panels located and marked for identification. Thus in Figure 25, showing a layout for a typical interior floor bay, observe that seven of the floor form panels are marked F-1. The fact that they all have the same mark means that they are all of the same size and shape and are interchangeable. Six other panels are marked F-2, which means that they are identical in size and shape and are interchangeable. A special panel only 10 inches wide, marked F-3, is placed just off the center line of the floor bay, and is put there as an aid to the shoring of the slab. It will be discussed later in this article. The panels marked P-1 in Figure 25 are those comprising the form work for the drop panels around the column head.

Figure 24 is the layout for a typical exterior floor bay (next to the outside wall). It contains a greater variety of floor form panels than required for an interior bay. In addition to the panels marked F-1 and F-2, there are two marked F-4, one marked F-5, one F-6, and two very small panels next to the haunch at the wall columns, marked F-11. Figure 24 also shows the location of some beam sides (B-1, B-2, B-3 and B-4), haunch sides H-1, H-2 and H-3, column sides marked C-1, C-2, C-3 and C-4, and the drop panel forms P-1.

The dimensions of these floor form panels will depend, of course, on the length of a floor bay and the dimensions of the drop panel around the column head; but for any particular building the actual dimensions will be shown on the layout that will correspond to Figures 24 and 25. The actual details of the floor form panels can be seen best in Figures 28 and 29, where they are shown in cross-section. Here they are seen to consist of ⅞-inch dressed boards nailed to 1-by-4 cleats. Details of other parts of the form work will be shown in other parts of the form details.

With layouts similar to those in Figures 24 and 25 in his possession, and knowing the details, the form carpenter foreman will know exactly how many of the floor form panels F-1, F-2, and so on, he will need for each of the exterior floor bays and for each of the interior bays. As fast as the various panels and other form units are made they are marked F-1, F-2, H-1, H-2, and so on, for the purpose of identification. It will then be an easy matter to assemble the form work properly, because with the layout at hand the form crew will know exactly where each of the units belongs on the framework of girts and joists shown in Figures 26 and 27.

Erection of Supports

Figures 28 and 29 show the form work supports most

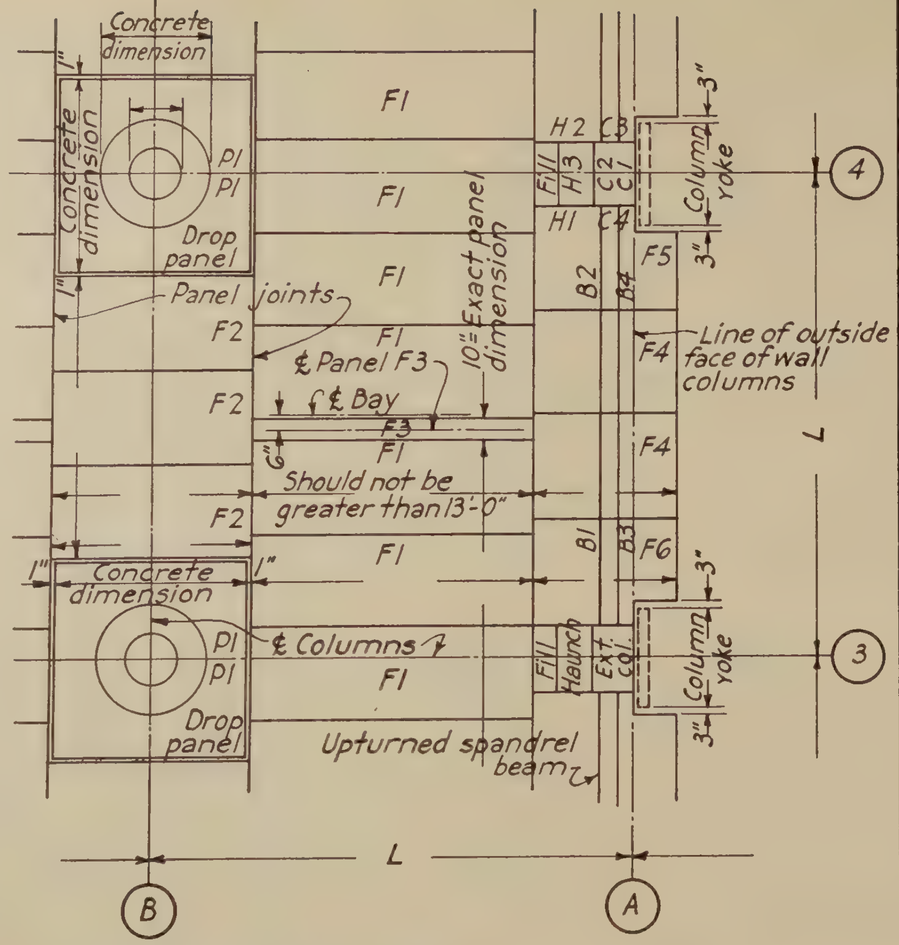


FIGURE 24-KEY PLAN, TYPICAL EXTERIOR FLOOR BAY

(Showing layout of form panels and markings for columns, haunches and spandrel beams.)

Note:- Allow $\frac{1}{8}$" clearance in all dimensions in all panels.

Note:- F3 panel is for reshoring and remains in place until all re-shores are removed.
Draw in panels on only one typical bay across building when making a key-plan.

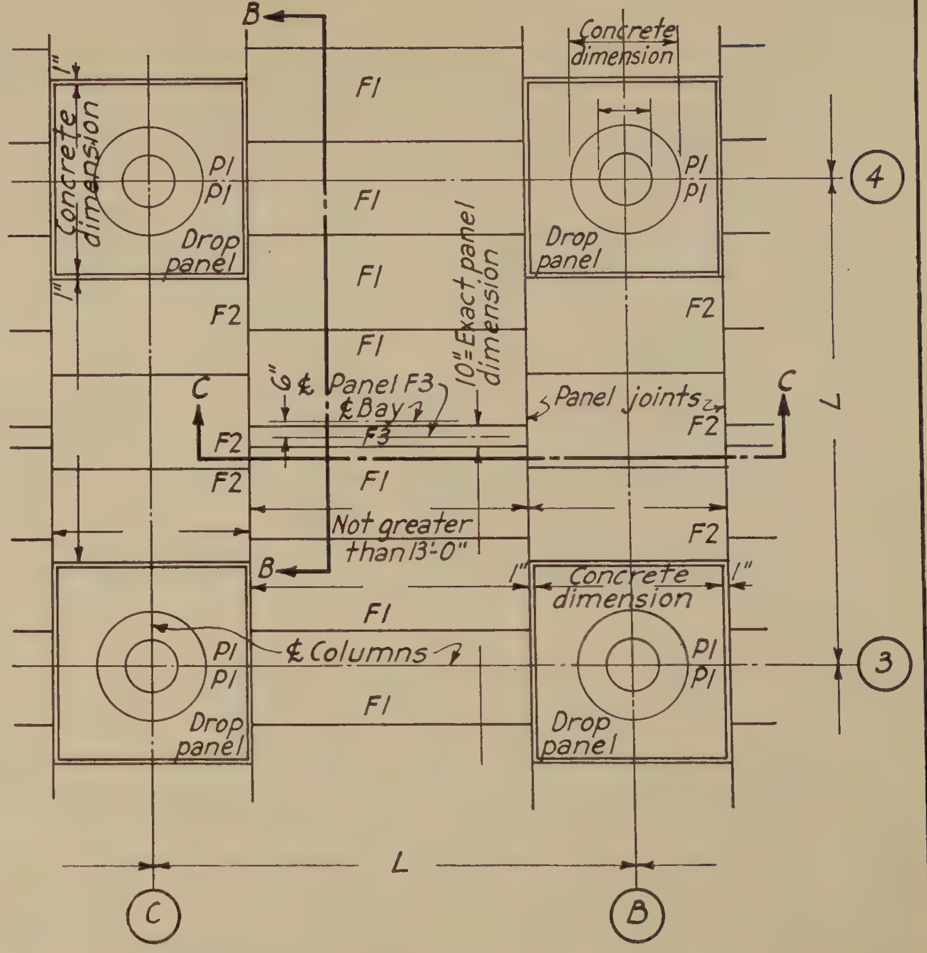
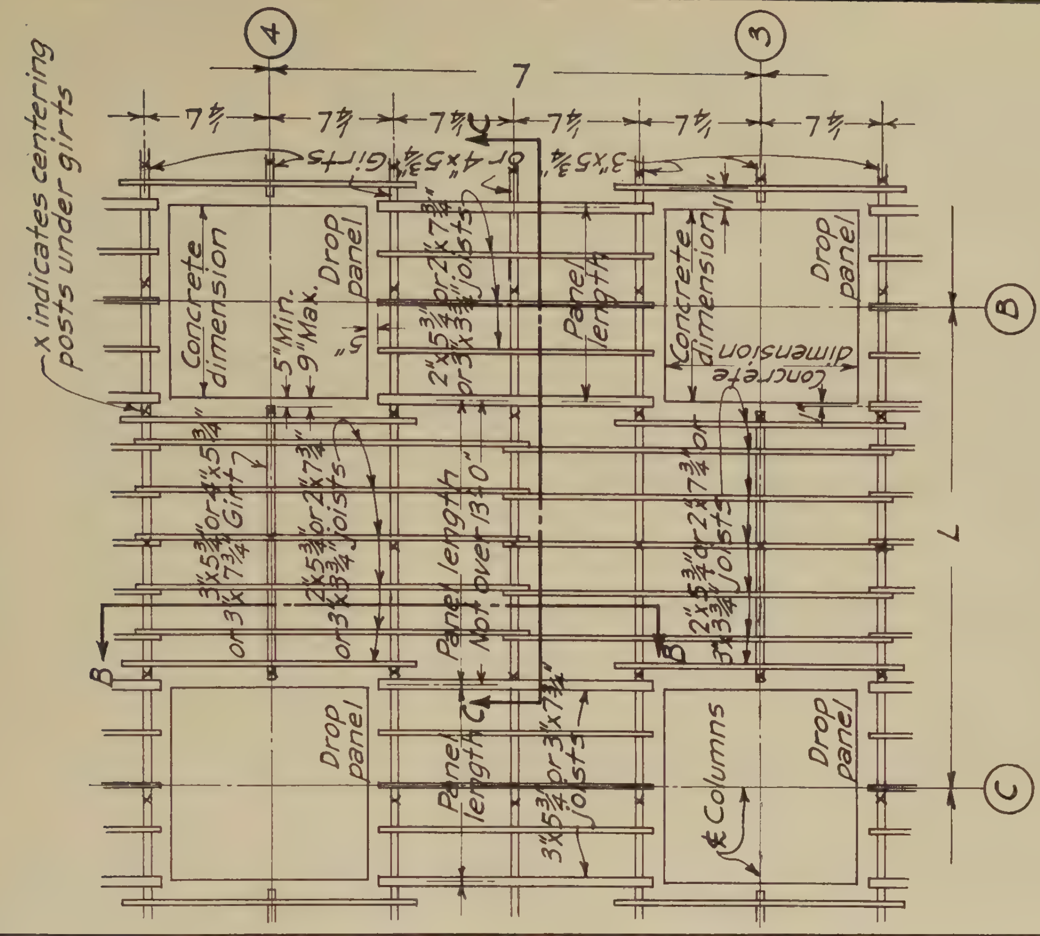


FIGURE 25-KEY PLAN, TYPICAL INTERIOR FLOOR BAY

(Showing layout of form panels)

Note:- Allow $\frac{1}{8}$" clearance in all dimensions in all panels

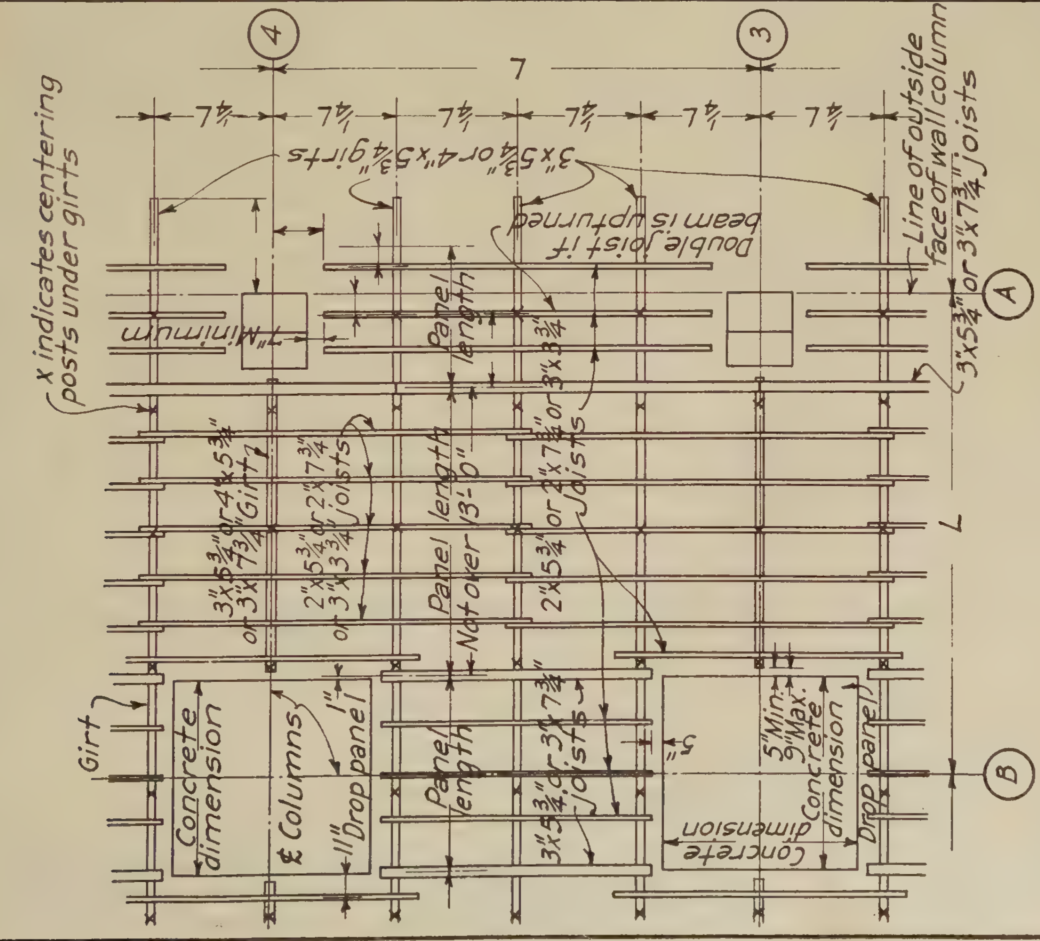
Note:- F3 panel is for re-shoring and remains in place until all re-shores are removed.
Draw in panels on only one typical bay across building when making key-plan


x indicates centering posts under girts
4
3
7
7'-½"
3"x5¾" or 4"x5¾" Girts
3"x5¾"
Concrete dimension
5" Min.
9" Max.
Drop panel
Panel length
2"x5¾" or 2"x7¾" or 3"x3¾" joists
B
C
3"x5¾" or 4"x5¾" or 3"x7¾" Girt
2"x5¾" or 2"x7¾" or 3"x3¾" joists
Panel length Not over 13'-0"
3"x5¾" or 3"x7¾" joists
℄ Columns
L

Note:- Use a single joist 3" in thickness for joist at panel joint. 5¾" or 7¾" dimension means sized stock; that is, 6" or 8" sized to 5¾" or 7¾"

FIGURE 27 - GENERAL ASSEMBLY TYPICAL INTERIOR FLOOR BAY

(Floor form panels omitted)


x indicates centering posts under girts
4
3
7
7'-½"
3"x5¾" or 4"x5¾" girts
Double joist if beam is upturned
Line of outside face of wall column
3"x5¾" or 3"x7¾" joists
A
B
7" Minimum
Panel length
2"x7¾" or 3"x3¾" joists
3"x5¾" or 4"x5¾" or 3"x7¾" Girt
2"x5¾" or 2"x7¾" or 3"x3¾" joists
Panel length Not over 13'-0"
Girt
Concrete dimension
℄ Columns
1" Drop panel
3"x5¾" or 3"x7¾" joists
5" Min.
9" Max.
Drop panel
L

Note:- Use a single joist 3" in thickness for joist at panel joint. 5¾" or 7¾" dimensions means sized stock; that is, 6" or 8" sized to 5¾" or 7¾"

FIGURE 26 - GENERAL ASSEMBLY, TYPICAL EXTERIOR FLOOR BAY

(Floor form panels omitted)

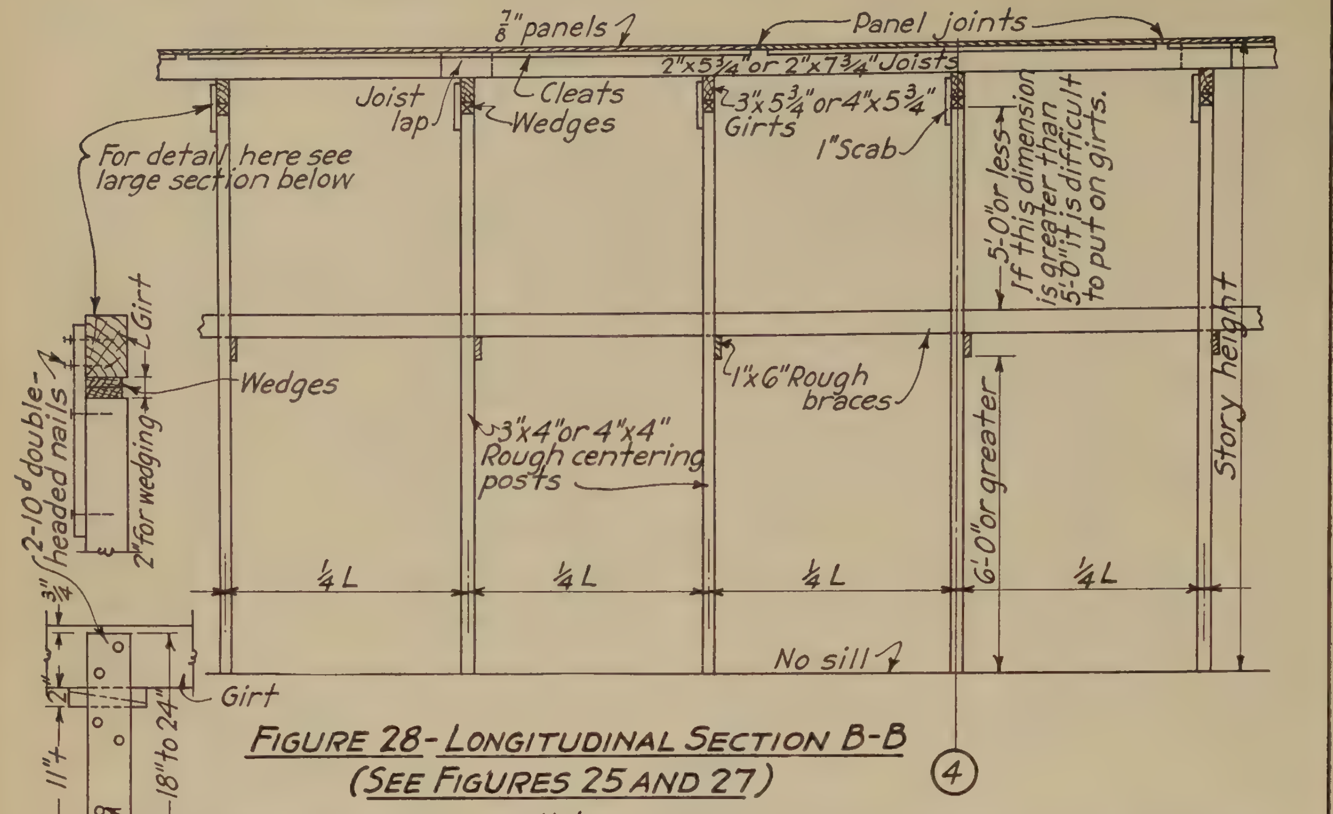


FIGURE 28- LONGITUDINAL SECTION B-B
(SEE FIGURES 25 AND 27)

Note:-
Size of posts, spacing and bracing are dependent upon thickness of slab, method of pouring and story height. See large sized detail for scabs, wedges and nailing.

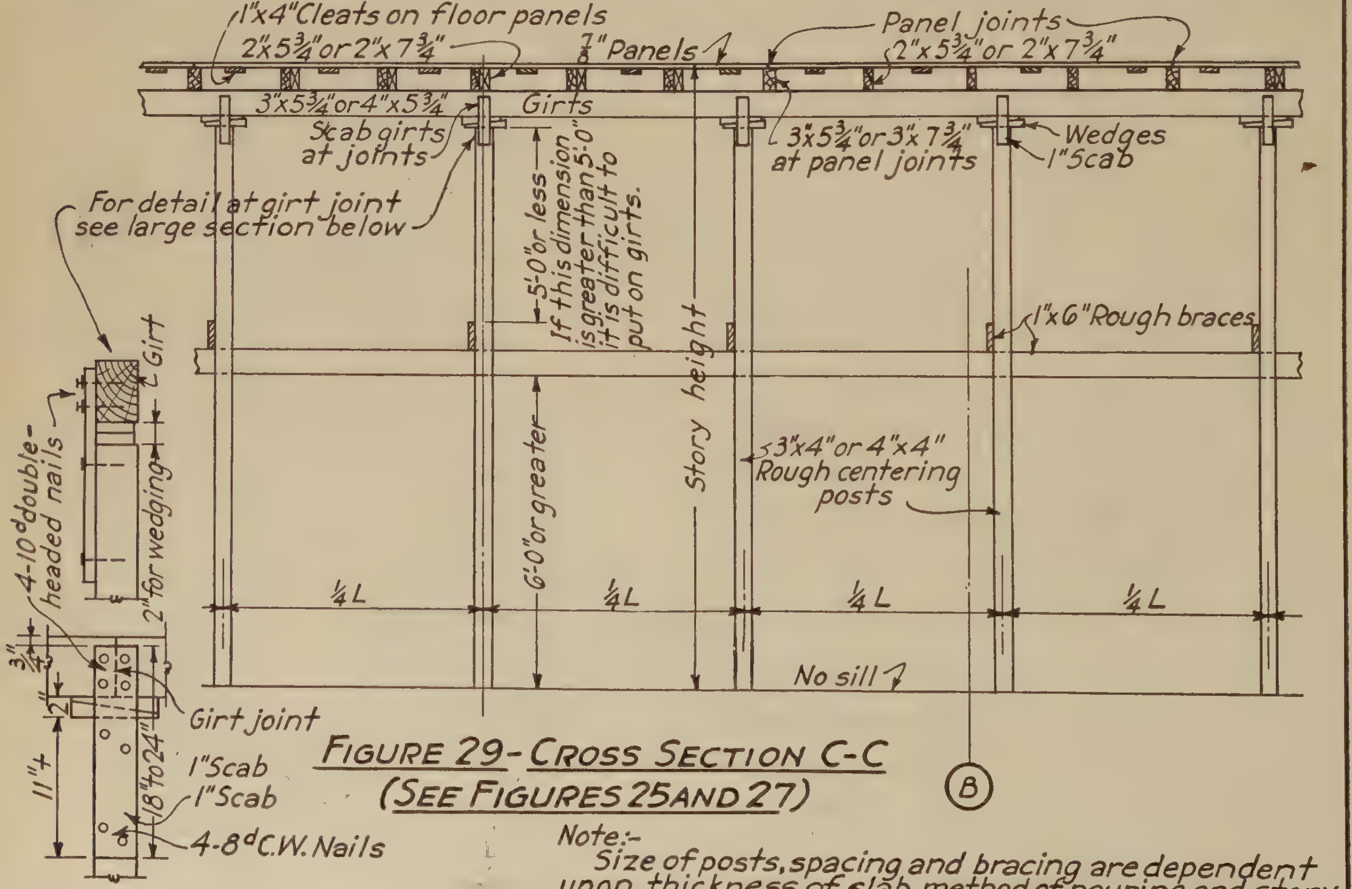


FIGURE 29- CROSS SECTION C-C
(SEE FIGURES 25 AND 27)

Note:-
Size of posts, spacing and bracing are dependent upon thickness of slab, method of pouring and story height. See large sized detail for scabs, wedges and nailing

clearly, although the exact location of the centering posts is shown also in Figures 26 and 27. For these centering posts we generally use 3-by-4's, undressed, and sometimes 4-by-4's. Horizontal braces of 1-by-6 rough boards are nailed to the posts in each direction, the lower set of braces being at least 6 ft. from the floor so as not to interfere with men moving around on the floor. The detail at the top of the centering posts is shown clearly, to a large scale, in Figures 28 and 29. Observe in that detail how provision is made for adjusting the level of the floor forms with wedges. After the adjustment is completed the 1-inch scabs, which have previously been nailed to the top of the posts, are nailed to the girts with double-headed nails.

From the large-scale details in Figures 28 and 29 it will be seen that the length of the centering posts is equal to the story height, less the depth of the floor boards, less the depth of the floor joists, less the depth of the girts, less the 2 inches allowed for the wedges.

With the posts and the girts in place, the joists are set in place, but are not nailed or otherwise fastened to the girts. The joists are spaced in accordance with the table in Figure 22, printed with the previous article of this series. That table provides for concrete slab thicknesses of as much as 9 inches. It is seldom that the slab thickness in a building of flat-slab construction exceeds 9 inches; but if it does, the joist spacing may be estimated from the table. Note that the ends of the joists are 5 inches from the edge of the drop panel around the column heads (See Figures 26 and 27), and 7 inches from the face of the wall columns. Details at the junction between the floor form panels and the form work for drop panels will be shown in the next article of this series.

The floor form panels are now placed into position, also without actually being nailed down to the joists.

Provision for Permanent Shores

Provision is made for substantial "permanent" shores near the center of the floor bay, by means of a special floor form strip or panel designated as F-3 in Figures 24 and 25. A brief mention of this special panel will be found in the notes in those two figures. The word "permanent," as here used, merely means that these shores are to remain in place much longer than the rest of the form work.

The special panel F-3 is made 10 inches wide and its center line is set 6 inches from the center line of the floor bay. This permits shoring timbers in any size up to 8-by-8's to be set up under panel F-3 without interference from the girt on the center line of the floor bay. Ordinarily three 6-by-6 timbers will be sufficient.

Setting the Permanent Shores

Before any of the form work of a floor bay is removed these "permanent" shores are set into place under panel F-3 and are fastened into place with wedges. The rest of the form work in the bay may then be removed as soon as it has attained sufficient strength to be self-supporting and to support the weight of the form work on the floor above. At ordinary summer temperatures panel F-3 and the "permanent" shores may be removed in 21 days; but the remainder of the forms may be taken down in 6 days. Under winter construction conditions the elapsed time must be longer in both cases.

It is extremely important to have the "permanent" shores in one story located exactly above the ones in the story below, so that the load will be carried by the more seasoned floors farther down. As stated in the preceding paragraph, the shores should be left in place for 21 days in ordinary summer temperatures, and a longer time under winter construction conditions. This means that shores will be in place in the upper three or four stories as the work proceeds.

Setting Re-Shores

In addition to the "permanent" shores under panel F-3, re-shores should be set, immediately after the form work is removed, in line with the columns. One 6-by-6 timber midway between columns should be sufficient. These should be left in place the same length of time as the "permanent" shores, and should in all cases be exactly above the corresponding re-shoring timber in the story below.

Stripping the Forms

Because of the absence of beams and girders the stripping of forms in flat-slab construction is comparatively simple. Since neither the joists nor the floor form panels are nailed down, they can be removed as soon as the wedges between the posts and the girts are loosened. The following is the usual procedure in the stripping schedule, coupled with the placing of shores:

(1) Set the "permanent" shores under panel F-3.

(2) Loosen the wedges between the girts and the top of the centering posts, but do not completely remove them.

(3) Turn the joists on their sides, allowing the floor form panels to drop down upon them.

(4) Remove enough of the floor panels and joists to permit setting of the 6-by-6 re-shoring timbers midway between columns. Then take down the remaining floor panels and joists.

(5) Remove the double-headed nails which hold the girts against the scabs at the top of the posts; then take the girts down.

(6) Remove the 1-by-6 horizontal braces and the centering posts.

Lowering Huge Concrete Caissons in New London Bridge

In the construction of the new Lambeth bridge, London, the second steel caisson, which will be filled with concrete to support one of the piers, has just been lowered to the bed of the Thames on the south side. The operation, which was carried out with hydraulic apparatus, took six hours, a total weight of 500 tons having to be lowered into the river.

The caisson is rectangular in shape, 108 feet, by 37 feet, and 15 feet deep. It will be sunk to a solid foundation about 25 feet below the river bed, and on top of it will be erected a temporary caisson inside which the pier will be constructed. Work is already in progress with the first caisson, which has been sunk on the north side of the river.

There will be four supporting piers for the bridge, which will consist of five spans. A roadway, 36 feet wide, is to be provided, and two footways 12 feet wide, bringing the width of the bridge to approximately 60 feet. It is estimated that the total weight of steel in the bridge will be about 4,000 tons. The contractors anticipate the completion of the bridge in 1932.

Colorado Cement Prices Permit Lower Highway Bids

The lowest figures in twelve years were given in bids made by contractors for the Colorado state highway department recently. Bids were $1.73½ a sq. yd. on one project and $1.80 on another. Two dollars had been the lowest for the past ten years.

Coloradoans have been informed that as a consequence concrete roads will cost $3,000 a mile less in 1930 than a year ago.

Building Construction Contracts Make Better Comparison with 1929

Indications that building construction has taken a turn for the better, continued heavy volume of awards for concrete highways, and a large volume of contracts for new construction by public utilities are the favorable factors in the March and early April construction reports. Unfavorable factors are seen in the continued failure of cities to speed up street paving work, and in the small drop in contemplated construction as compared with February.

New Building Construction Reviving

"Building construction throughout the United States has definitely taken a turn for the better," says the monthly building survey for March issued by S. W. Straus & Co. "Building permits issued in 583 representative cities in every part of the country totaled $187,270,891 in March, compared with $128,043,217 in February." This is an increase of 46 per cent, whereas the normal expected increase from February to March is 37 per cent. In the 25 cities having the greatest building activity, March building permits exceeded February permits by 65 per cent.

Comparison with March, 1929, when permits totaled $408,931,092, is without value because $171,000,000 of that amount, in New York City alone, was a wholly abnormal volume that was filed because of the pending state legislation on multiple dwellings.

Building Contracts Getting Closer to 1929 Figures

Contracts for general construction work awarded by public works departments and public utilities are well ahead of March, 1929, as reported by the F. W. Dodge Corp. While the value of building contracts awarded in March are still about $62,000,000 lower than in the corresponding month of last year, the figures are crawling up on the 1929 awards. Specifically, the total value of building contracts was about $72,000,000 less in February, and about $131,000,000 less in January, than in the corresponding months of 1929. The Dodge figures follow:

CONTRACTS AWARDED IN MARCH

	1929	1930
Buildings	$413,339,300	$350,769,200
Public works and public utilities	71,508,200	105,349,800
Totals	$484,847,500	$456,119,000

CONTRACTS AWARDED IN FIRST 3 MONTHS

	1929	1930
Buildings	$1,060,466,100	$793,907,300
Public works and public utilities	195,623,200	303,239,900
Totals	$1,256,089,300	$1,097,147,200

Contemplated construction in March was $508,875,900 for buildings and $223,860,000 for public works and public utilities, making a total of $732,735,900, compared with $780,778,400 in February and $886,075,100 in March, 1929.

Concrete Highway Contracts Far Ahead of Last Year

Contracts awarded for concrete highways in March were far ahead of the corresponding figures of 1929, according to reports received by the Portland Cement Association. Total awards in March were 11,294,228 sq. yds., compared with 2,825,781 sq. yds. in March, 1929. During the first 12 days of April the concrete road awards totaled 5,563,777 sq. yds., compared with 5,983,679 sq. yds. during the first 13 days of April, 1929. Street and alley pavements are still lagging behind last year. The comparative figures follow:

SQUARE YARDS OF CONCRETE PAVEMENTS AWARDED

	Jan. 1 to Apr. 13, 1929	Jan. 1 to Apr. 12, 1930
Roads	16,587,492	27,459,172
Streets	7,284,423	6,468,585
Alleys	516,694	422,137
Total sq. yds.	24,388,609	34,349,894

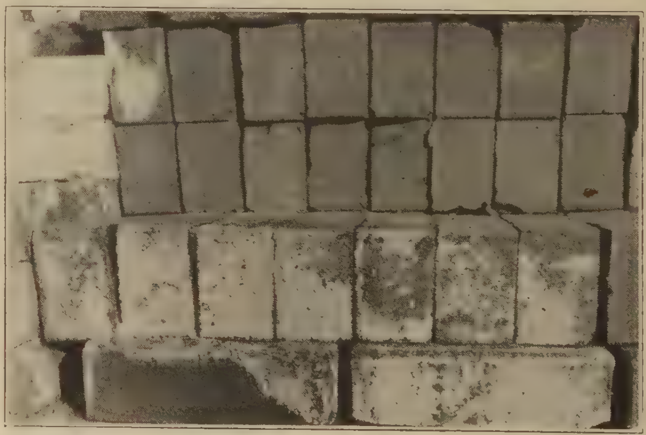
Cement Shipments

Shipments of portland cement from the mills totaled 8,846,000 barrels in March, compared with 7,012,000 barrels in February and 10,113,000 barrels in March, 1929.

Efflorescence Not Necessarily Due to Mortar

Architects sometimes object to the use of cement or cement-lime mortar with brick work and stone masonry in the belief that efflorescence from the mortar might mar the surface of the wall.

It is well known that efflorescence may appear not only on concrete or cement mortar, but also on clay brick or natural stone. Efflorescence is likely to appear on the surface of any of these materials if the material itself is sufficiently porous to permit the penetration of water during rain storms. When the water enters the material it dissolves certain salts which come to the surface with the water after the rain is over. When the water evaporates the salts are left on the surface to form what is generally called efflorescence. Lime carbonate is one of the salts so deposited.



Efflorescence on brick in stock piles in yard of brick plant shows salts came from the material itself

The occurrence of efflorescence on the surface of clay bricks as the result of salts dissolved within the brick itself is well shown by the illustration taken from a photograph of a stock pile of brick in the yard of a Pacific Coast manufacturer, where there was no possibility of the trouble having originated in mortar. Some brick had been removed from the stock pile just before the photograph was taken. The newly exposed brick, which had previously been protected by the bricks just hauled away, had no efflorescence on them. The bricks in the lower part of the picture and to the left had been exposed to the weather for some time and were coated thickly with efflorescence.

New Pycnometer Measures Free Moisture in Aggregates

Engineers of Tennessee State Highway Department Develop Equipment That Is Accurate to One-Tenth of One Per Cent

By D. D. McGUIRE
Engineer of Tests

and

W. H. ROWAN
Research Engineer,
Tennessee State Highway Dept.

THE Tennessee Highway Department chose to control the proportions of fine and coarse aggregates to be included in concrete mixtures by weight and changed the specifications of all contracts let subsequent to June, 1928, to make this control mandatory. They soon realized that one of the major factors of this type of control was accurate knowledge of the correct per cent of free moisture in the aggregates and their apparent specific gravity. The device shown in the illustration is the result of several revamped pieces of equipment for this purpose and represents a practical means of determining these two factors on relatively large samples of materials.

Container Dimensions

The container, or moisture can, is made of a non-corrosive, metallic material, such that its base is 10 inches in diameter, and top 3 inches in diameter. The height of the can is 12 inches. Under the bottom are placed three round points of contact with the weighing table of a solution balance. The bar placed on the top of the can carries at its mid-point a circular rod sharpened to a point. A very small notch in the circumference of the top of the can and on each end of a diameter permits the bar always to be placed in the same position.

The moisture gauge bar with its pointed rod forms an extremely accurate endpoint for the volume of water contained within the moisture can. When the tip of the point breaks the surface tension of the top of the water, a definite change in the condition of the meniscus takes place, and an accurate endpoint is assured.

Determination of Specific Gravity

To determine the apparent specific gravity, it is only necessary to determine the weight of the can and bar, the water which the can will contain to the point where the moisture gauge bar touches its surface, and the weight of the sample under consideration. To determine free moisture, the apparent specific gravity, G_s, in a saturated and surface-dried condition, and the apparent specific gravity, G_w, in a wet or stock-pile condition, are required. From the formula,

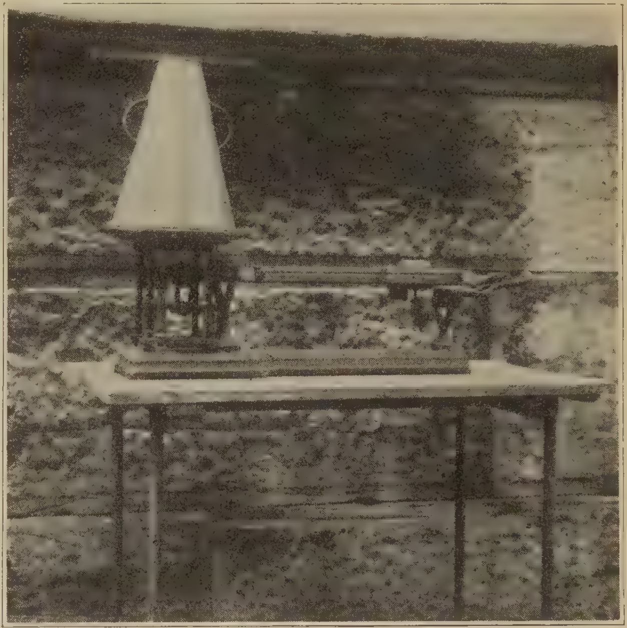
$$\frac{G_s - G_w}{G_s \times (G_w - 1)} \times 100 = M,$$

the per cent moisture may be readily obtained. This is further set up for ready reference in a chart.

For any one job and any set of materials, G_s will remain a constant over a considerable period of time. This factor is checked daily on Tennessee's construction work and the factor, G_w, is determined at relatively short periods, depending upon knowledge of moisture conditions in the stock-pile.

Large Samples Possible

The advantage of this particular equipment is the fact that a sample as large as twenty pounds may be used and the errors attendant to determinations with small samples will be practically eliminated. The container is made of metal and is a practical piece of field testing equipment. The accuracy of the test has been shown from samples of predetermined moisture content and have been within 0.1 per cent when only reasonable care is taken in its manipulation.



New type of pycnometer for determination of free moisture in concrete aggregates, developed by Tennessee State Highway department engineers

Tennessee has used this equipment satisfactorily for the past two years with excellent results. We feel that it is a method of obtaining accurate and practical results which can be relied upon.

A. S. C. E. Meeting

The spring meeting of the American Society of Civil Engineers was held at Sacramento, Calif., April 23rd to 25th.

Burned Wooden Roof on Concrete Building Results in Water Damage

Concrete Structure Not Affected, But Much Damage Caused by Water—How Designers May Avoid Similar Occurrence—Construction Details of Destroyed Roof

A fire which destroyed a temporary wooden roof of large area on the Breslin Building, a six-story reinforced concrete office building in Louisville, Ky., on March 22nd, and resulted in considerable water damage to the ceilings and walls, has brought to light certain facts which should be taken into account in designing similar structures.

This building has floor slabs 2 in. thick over 8 in. reinforced concrete beams. The ceilings are of plastered expanded metal, fastened direct to the underside of the concrete floor beams. The building is so designed that additional stories can be added when needed, so that the ceiling construction of the top story would become the floor construction for the next story above. Over this future floor a wooden roof was constructed, consisting of 1 in. sheathing on 2 by 10 joists covered with tar and gravel roofing and supported every sixteen feet by a line of short 2 by 4 studs.

The height of the space under this temporary roof varied from four to six feet, the outside building walls having been extended well above the roof. Air shafts and pipe shafts from floors below extended into this roof space.

The fire is believed to have originated in one of these pipe shafts. Sufficient combustible material was in the shaft and its enclosures to communicate the fire to the wooden roof above, where it spread over the entire roof area under the tar and gravel covering.

The fire department, being unfamiliar with the structural design of this temporary roof, was baffled. Water was poured on the roof while the fire spread underneath. A section of the wooden roof construction finally collapsed, after which the fire fighters succeeded in getting the water to the fire. About half of the wooden roof was consumed. The remainder was so badly burned that it collapsed.

The concrete slab under the temporary roof suffered practically no damage, which leads to the belief that a much smaller loss would have resulted had the fire been permitted to burn itself out. As it was, aside from the destruction of the wooden roof, heavy loss was caused by water damage to the walls, ceiling, floor coverings, and wiring.

In the same city there are several fireproof buildings of large area with so-called temporary wooden roofs similar to the one on the Breslin building. Designers of such temporary roof structures can prevent a similar occurrence by providing incombustible fire stops and extending all shafts to a height at least 18 in. above the temporary roof. The ceiling of the top story should be made watertight by filling in the space around all pipes, and scuppers should be provided for drainage.

Figures on Construction and Improvement of Airports

Construction and improvement of airports is continuing steadily. Since January 1st, Birmingham, Alabama, has passed a million dollar bond issue; Tulsa, Oklahoma, a bond issue for $650,000 and Des Moines, Iowa, a bond issue for $200,000 for airports. Atlantic City, New Jersey, approved a $50,000 bond issue for repairs and improvements at its existing airport. Philadelphia a few weeks ago approved the purchase of the Hog Island site for a municipal airport. The sum of $750,000 is available for immediate construction. Construction is going on at a number of fields, the largest projects being those of the government for the army fields at March Fields, California, Randolph Field, Texas, and Maxwell Field in Georgia. The appropriations for 1930 construction at these fields amount to several hundred thousand dollars.

Several cities are preparing plans for administration buildings. Minneapolis received bids on March 22nd on an administration building of reinforced concrete, two stories and basement, 40 by 143 ft. The low bid was $52,585.

Portland, Oregon, has awarded 16,170 sq. yds. of 8-in. plain and reinforced concrete pavement on the approach to Portland's municipal airport. The contract price of $132,209 includes an overpass and an underpass.

International Road Congress to Be Held in Washington in Fall

For the first time a congress of the Permanent International Association of Road Congresses will meet in the United States, when, on October 7th to 10th the sixth gathering of its kind is held at Washington, D. C.

One of the features of the Congress will be an exposition of highway building equipment and material, to be held under the auspices of the American Road Builders Association. This exposition will be held in the Washington Auditorium, while demonstrations of the equipment will take place in the open air.

The congress is being held in Washington at the invitation of the United States Government.

It is expected that delegates from more than fifty nations will be in attendance at the sixth congress and material benefit is expected to result to road construction programs from the mutual interchange of ideas and experiences. The first congress was held in Paris in 1908 at the invitation of the French government. Other congresses were held in Brussels in 1910, in London in 1913, in Seville in 1923 and in Milan in 1926. The meetings in Washington will begin Monday, October 6th, and close Saturday, October 11th.

$1,600,000,000 for 1930 Improvements on U. S. Highways

An announcement by the Bureau of Public Roads indicates that the sum of $1,601,167,455 will be available for highway improvements in 1930. The planned expenditure for the construction and maintenance of highways totals $937,500,455 while the balance, $663,667,000, will be spent, according to the estimate, on local roads and bridges. Officials of forty-five states, is was said, had estimated the length of roads to be improved in 1930 at 32,532 miles, or 3,126 miles more than in 1929.

Sewer Pipe Association Moves

The Reinforced Concrete Sewer Pipe Manufacturers' Association has announced its removal to 1449 Leader Building, Cleveland, Ohio.

It was formerly located in Newark, New Jersey.

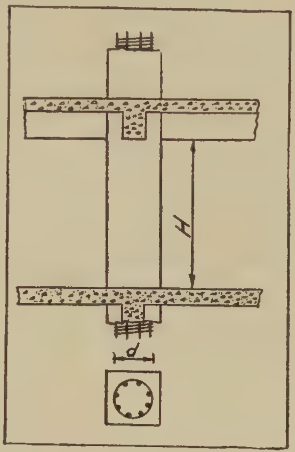
Reinforced Concrete Design Simplified

Chart M_1 (3000;10)
Spiral Reinforced Columns

By JAMES R. GRIFFITH
Professor of Structural Engineering, Oregon State Agricultural College

American Concrete Institute Building Code

$f'_c = 3{,}000$ lbs. per sq. in.
$f_c = 300 + (0.10 + 4p)f'_c$
$n = 10$
$P = A_c[1 + (n\text{-}1)p]f_c$
A_c = area within the spiral hooping
h/R = less than 50
Spiral steel not less than $A_s/4$



EXCEPT for slight differences in notation, the formula specified by the American Concrete Institute for spiral reinforced columns is identical with that in the Joint Committee Specifications.

The charts thus far presented for the solution of reinforced concrete beams under the A. C. I. Code, have been designed to include two classes of concrete:

$$1\begin{cases} f'_c = 2{,}000 \text{ lbs. per sq. in.} \\ n = 15 \end{cases}$$
$$2\begin{cases} f'_c = 2{,}500 \text{ lbs. per sq. in.} \\ n = 12 \end{cases}$$

Many designers are using high strength concrete for their columns. So it was considered advisable to present a chart for column design which would include concrete of a higher strength than had been used for beams. Chart M of the original series is applicable under the A. C. I. Code for the strength used:

$f'_c = 2{,}000$ lbs. per sq. in.
$n = 15$

Chart M_1, herein presented, has been designed for ultimate strength concrete of

$f'_c = 3{,}000$ lbs. per sq. in.
$n = 10$

Attention is also called to the fact that under the A. C. I. Code these charts are applicable to columns of ratio h/R up to 50, whereas under the Joint Committee Specifications 40 was the limiting value.

While the columns of many buildings have been designed for higher strength concrete than the beams and slabs, it should be done with extreme caution. When rigid inspection is maintained, this practice is perhaps justifiable. We have yet to develop workmen who will take the proper interest in the mixing of concrete. I know of some buildings where the lower strength concrete has been used throughout, regardless of the fact that the designer figured on higher strength concrete for the columns.

Use of Chart M_1

In the original series a problem was solved for the following conditions:

Total column load, $P = 400{,}000$ pounds,
Column dimensions
Overall 24 by 24 in.
Core diameter = 20 in.

Using 2,000 lb. concrete, this column was found to require longitudinal steel (A_s) of 12.2 sq. in.

Using 3,000 lb. concrete, from Chart M_1 I obtain the following values:

Isopleth (1)
$P = 400{,}000$ lbs.
Diameter = 20 in.
$p = 0.0324$

Isopleth (2)
Diameter = 20 in.
$p = 0.0324$
$A_s = 10$ sq. in.

Thus a saving of 18 per cent in longitudinal steel is obtained.

Construction of Chart M_1

The allowable stress in the concrete of a spiral reinforced column is given by the equation

$$f_c = [300 + (0.10 + 4p)f'_c]$$

For a value of $f'_c = 3{,}000$, this reduces to the form

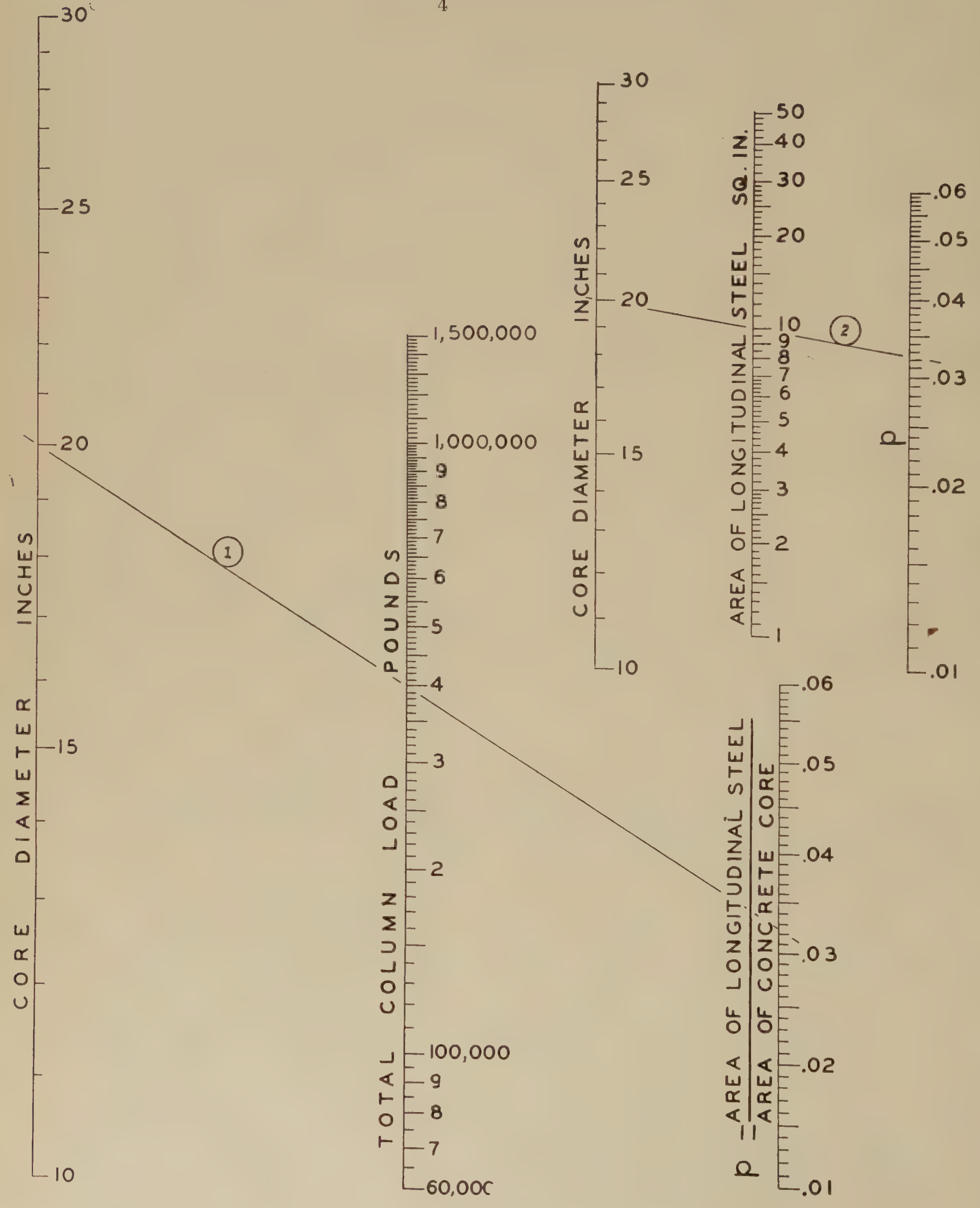
$$f_c = 600 + 12{,}000\,p$$

CHART M$_1$

Spiral Reinforced Column

$f'_c = 3{,}000$ lbs. per sq. in.
$n = 10$
$h/R =$ less than 50

$$\text{Spiral steel} = \frac{\text{Longitudinal steel}}{4}$$



The total permissible column load is found by the equation

$$P = A_c\,[1 + (n\text{-}1)\,p]\,f_c$$

A_c = area within the spiral hooping

Substituting the values

$$f_c = 600 + 12{,}000\,p$$
$$n = 10$$

the total permissible column load then becomes

$$P = A_c\,(600 + 17{,}400\,p + 108{,}000\,p^2)$$

$$\text{or } P = \frac{3.1416\,d^2}{4}\,(600 + 17{,}400\,p + 108{,}000\,p^2) \quad \text{Eq.1-M}_1$$

Unlike the expression found in the original series, this value

$$(600 + 17{,}400\,p + 108{,}000\,p^2)$$

was not a perfect square. So a slightly different method of attack was used.

If I let

$$y = 600 + 17{,}400\,p + 108{,}000\,p^2$$

Eq. 1-M reduces to the form

$$P = \frac{3.1416\,d^2}{4}\,y \qquad (1)$$

Since about the same limits were desired for this chart, I assumed the same scale spacing, making

$$n = \tfrac{1}{2}$$

Also the same scales were assumed for (L) and (C) as previously used, making

$$m = 2$$

Equating the general exponents of Eq. 7

$$C = L^{mn/r} \,.\, R^{m(1-n)} \qquad \text{Eq. 7}$$

to the specific exponents of expression (1), I have

$$\left.\begin{aligned} mn/r &= 2 \\ m(1-n) &= 1 \end{aligned}\right\}$$

Now substituting the assumed values of $m = 2$ and $n = \tfrac{1}{2}$, I obtain a value of

$$r = \tfrac{1}{2}$$

Using the D-20 scale for (L) values of d, and the A-10 scale for (C) values of P, I must then use the D-10 scale for values of (y) on (R). I then prepared Table 1-M_1 for values of (p) and

$$y = 600 + 17{,}400\,p + 108{,}000\,p^2.$$

TABLE 1-M_1

Values of (p)	*Values of* (y)
0.01	785
0.015	885
0.02	991
0.025	1102
0.03	1219
0.035	1340
0.04	1469
0.045	1601
0.05	1740
0.055	1885
0.06	2013

A construction isopleth was then assumed through values of

$$d = 10 \text{ in.}$$
$$p = 0.01$$

giving on the central scale a value of

$$P = 61{,}600 \text{ lbs.}$$

The (d) and (P) scales were then plotted as before. In plotting the (R) scale for values of (p), the D-10 scale was placed so as to give a reading at the construction isopleth of ($y = 785$). The various values of (y) from Table 1-M_1 were then plotted but labeled their corresponding value of (p). Fig. 1-M_1 gives the details by which the original of this chart was constructed.

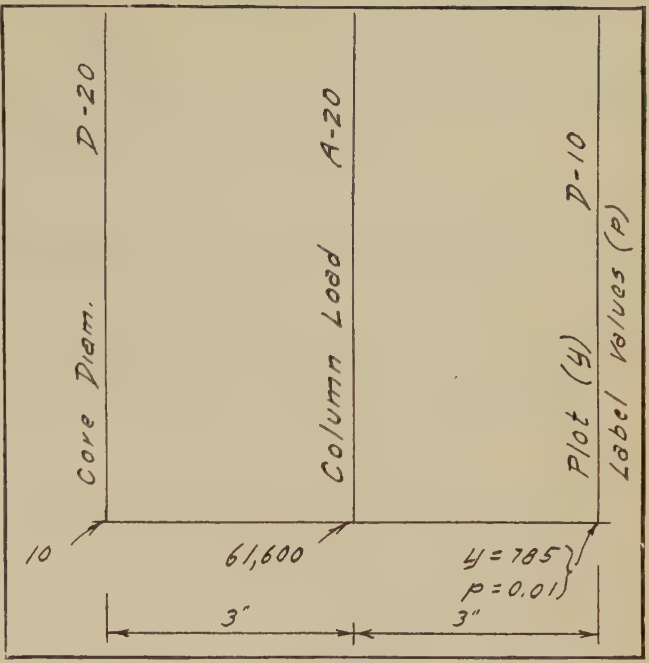


Figure 1-M_1

The small nomograph giving the area of the longitudinal steel is identical to that used before so will need no explanation.

Rail Steel Bar Association to Meet in New York

The Rail Steel Bar Association will hold its regular semi-annual meeting May 9th at the Commodore Hotel, New York City.

This association, organized in 1912, includes in its membership many of the large rail steel mills of the United States and Canada. It is a technical organization formed for the purpose of co-operative research in production methods and the extension of reinforced concrete construction.

Adoption of Silo Ethics Code Results in Progress

As an example of what should be embodied in a code of ethics, the code adopted by the National Silo Research Council was published in the April, 1930, issue of CONCRETE.

The following comment was subsequently received from A. L. Haecker, secretary-treasurer of the National Research Silo Council:

> Thank you for calling my attention to the article in the April issue of CONCRETE on the National Silo Research Council's code of ethics.
>
> I am very glad to report that since writing this code and getting some fifty companies to sign, more progress has been made in clearing up bad practices than we have experienced in years back. I am sure the industry believes this is a good move and feels that it is a worthy effort and something which should be fostered and promoted.
>
> A. L. HAECKER, Secretary-Treasurer
> National Silo Research Council
> Lincoln, Nebr., April 7, 1930.

INFORMATION *and* CONSULTATION

THE HOW-TO-DO-IT DEPARTMENT

These columns are devoted to helping readers solve their problems in all phases of concrete work. Inquiries are invited. Where readers can add to or improve upon the suggestions printed, in answer to inquiries from others, they are also welcome to submit their views for possible publication.

How Concrete Affects Aluminum Metal

What effect, if any, is likely to result when fresh concrete comes into contact with aluminum metal?—M. L. W., Los Angeles, Calif.

The water in freshly mixed concrete becomes nearly saturated with calcium hydroxide within one minute after it is added to the mixture. This creates an alkaline condition that causes fairly rapid corrosion of aluminum metal. The mixing water is probably the most destructive to aluminum metal when it is from one-third to one-half saturated with calcium hydroxide. When it is more than half saturated a crystalline calcium aluminate is precipitated on the surface of the metal, and this coating tends to retard the rate of corrosion.

One could hardly expect aluminum metal to give satisfactory service in locations such as the lining of spouts or distributing chutes. While the concrete would slide well on a new aluminum metal surface, the metal would soon become pitted. Very likely the cost of frequent replacement would more than offset the advantages gained.

Glossy Finish on Cast Stone

I am starting the manufacture of concrete monuments and have been trying to find a chemical or something that will produce a glossy finish on cast stone without mechanical polishing. Can you give me any information on this?—R. D. B., East Point, Ga.

Several companies have products on the market which are said to produce a glossy finish without requiring polishing after the molds are removed. One company recently obtained the American rights on a foreign product which is essentially an integral waterproofer. It is chemically inactive and does not affect the strength of concrete either way. Samples which we have seen had a glossy and colorful finish when removed from the molds. It is our impression that this product is to be placed on the market soon.

Exposed Aggregate Finish for Cast Stone

Is mica needed to make cast stone look like natural stone, and is an acid wash necessary to give the best finish?—O. R. C., Avon, Ill.

Some types of special aggregates for cast stone produce a good appearance without mica, but it may be said that mica will improve the appearance of any cast stone, regardless of the aggregate used.

The use of an acid wash is one of several approved methods of removing the surface film of cement and exposing the aggregates. If a period of time ranging from 6 to 24 hours has elapsed between casting the concrete and the removal of molds, the surface film of cement can probably be removed by scrubbing with a stiff brush and clean water. If the concrete has been setting for more than 24 hours the cement film will probably be too hard to be removed in that manner. In this event, the aggregates may be exposed by scrubbing the surface with a solution of 1 part of muriatic acid to 3 parts of water. If a weaker solution will do the work it should be used. All traces of the acid must be removed by washing the surface with a generous supply of clean water.

Statuary, garden ornaments and similar products whose shape makes scrubbing impracticable may be immersed in a bath of muriatic acid solution, of the same strength as required for scrubbing. If the cement film has a greater thickness on some parts than on others, the product should be removed and the thicker areas of film should be scrubbed off.

Concrete Logs for Cabins

I am about to close a contract to build a log cabin hunting lodge. My clients would like to have the walls fireproof. How may such logs be made of concrete?—E. F. A., Bay Shore, N. Y.

Concrete "logs" for a purpose similar to this have been made by casting in waste molds of plaster. The builder brought in from the woods actual logs of the size and appearance desired. He cut four or five logs for each straight stretch of wall, so as to avoid repetition in appearance.

The wooden logs were then notched and shouldered to fit properly at corners, after which the plaster molds were made for them in the usual way. Four small bars, ½ in. round or square, should be placed in each log. One bar should be near the top, one near the bottom, and one near each side, about 1½ in. clear from the face of the mold. These bars permit the log to be lifted with any side up, without danger of breakage from ordinary handling.

Design of Concrete Mixtures

Where can I get a copy of "Design of Concrete Mixtures," published as Bulletin No. 1 of the Structural Materials Research Laboratory of Lewis Institute?—A. A. S., San Bernardino, Calif.

The publication about which you inquire is no longer in print. A more recent booklet on the same subject, entitled "Design and Control of Concrete Mixtures," may be obtained from the Portland Cement Association, 33 West Grand Avenue, Chicago.

Merchants of New Orleans Beautify Canal Street

Vast Amount of High-Grade Concrete Work Used in Dressing Up Famous Thoroughfare—New Sidewalks Built and Obstructions Removed—Walks Have Terrazzo Finish and Colored Borders—Remarkable Improvement in Appearance of Street

Here is a chance for a concrete builder with real selling ability to promote the beautification of individual business streets, the improvement to be financed by the retail merchants along the street. The improvement of Canal Street, in New Orleans, was so financed. The appearance of the transformed street was so attractive that the merchants along Baronne Street in the same city promptly organized similarly and improved that street with attractively colored concrete walks and lighting standards.

CANAL Street, in New Orleans, is one of the famous thoroughfares of North America. Its beautification had been talked of for years. It is now completed, thanks to the merchants along the street, who voluntarily financed the work.

Sidewalk and roadway widths have been changed; sidewalks with red borders and exposed aggregate surface have been built; street railway tracks have been reconstructed; ornamental lighting standards each carrying 3 high candlepower globes form a double line beside the two roadways; and all poles supporting balconies, signs and awnings have been removed from the sidewalk, leaving only the posts for mailboxes, street signal standards and an occasional fire hydrant as sidewalk obstructions.

Sidewalks and Neutral Ground Reconstructed

That portion of the improvement of particular interest is the reconstruction of the street railway tracks and of the sidewalks. The new construction begins at the Mississippi River and extends to Claibourne Ave., a distance of 6,000 ft.

Canal Street is 170.5 ft. wide. This width is divided into two 21-ft. sidewalks, two 35-ft. roadways and a 58.5-ft. middle portion called the neutral strip. This neutral strip is occupied by 4 street railway tracks, while the area between the double track in the center and the two single tracks along the edge is used as sidewalk. Before the present improvement the sidewalks were only 18 ft. wide but this was increased to 21 ft. by making each roadway and the neutral strip 2 ft. narrower.

All Old Walks Removed

The walks between curb and property line were built first. All the old walks were removed, regardless of their condition, and new walks 5 in. thick were laid in their place. These consisted of a 4-in. 1:3:6 base and a 1-in. 1:2 top. The top portion was divided into squares, by brass strips, and a red border 23 in. wide was made along the curb and along the property line.

Concrete is forced against the rail by a compressed air tamp

Special Aggregates in Top Course

The coarse aggregate for the uncolored portion of the top was one part Crown Point spar and one part white marble. For the red border the aggregate was pink Georgia marble. This latter was purchased in 3 sizes and 4 parts of fine, 3 parts of medium and 3 parts of coarse were mixed to get a well graded material. After the top had been struck off and smoothed, white marble chips were scattered on the uncolored portion and imbedded in the concrete by rolling with a light hand roller. Pink marble chips were rolled into the colored border.

Use of Red Iron Oxide

The red border was obtained by mixing red iron oxide into the concrete. The specifications required that 7 lbs. of red iron oxide be used for each 100 lbs. of cement, but the exact amount of coloring matter incorporated in this mixture depended upon the amount of iron oxide it contained and it was found less expensive to use 8 lbs. of color containing 86 per cent iron oxide than 7 lbs. of pure oxide. The mineral color cost about 18 cents per pound.

The fresh concrete base is marked by running a trowel along a straight edge and brass strips are set in the marks

Concrete from Central Proportioning Plant

Concrete for the base course was mixed at a central proportioning plant and hauled in trucks to its place in the walk. The top course was mixed by hand, in boxes, near where it was to be used.

Concrete containing 7 pounds of red iron oxide per 100 pounds of cement forms a border along the rails

Placing the Brass Strips

The brass separator strips were placed by marking the base course with the point of a trowel run along a straightedge and setting the strips in the groove thus formed. The top course was put on as soon as the brass strips were in place, before the base had time to harden, to assure a bond between them. After the top course had been in place 72 hours the surface was ground off with an electrically operated grinding machine, until the aggregate was exposed, giving a terrazzo finish.

White marble chips are cast on the surface and embedded with a light roller

Since it was important to both the street railway company and the merchants of Canal Street to have the street opened to traffic at the earliest possible date, high early strength cement was specified for all concrete work. The cement was required to develop a tensile strength in 1:3 mortar briquettes of 225 lbs. per sq. in. in 24 hours and 325 lbs. in 48 hours.

After the concrete has hardened for 72 hours the surface mortar is removed by an electrically operated grinding machine, to expose the coarse aggregate

The improvement has given Canal Street a "dressed up" appearance that is difficult to comprehend without actually seeing it. The entire street has a bright and clean-cut appearance, a fact which has already caused comment to the effect that some of the older business buildings will need cleaning to make the transformation complete.

Concrete Benches a Necessity in Greenhouses

Permit Steam Sterilization of Soil and Eliminate Repair Bills —Concrete Walls for Ground Beds Equally Successful— Economy Demonstrated by Seven Years of Use — Local Greenhouses May Need Similar Concrete Work—Opportunity for the Business-Getter

By WALTER B. BALCH
Department of Horticulture, Kansas State Agricultural College, Manhattan, Kans.

A BIG item in the management of a greenhouse is the replacement, every few years, of the wooden soil benches. This expense is not only for lumber used, and the labor involved in pulling down the old benches and building the new, but also in moving the soil in the benches out of the houses and later carrying it back. Often this requires so much time that a summer crop, that might be raised in the greenhouse, is lost.

Up to a few years ago the moving of the soil was not regarded as a serious expense because it was thought that after a few years the soil in a greenhouse became "sick" and was of no further value for the growing of plants until it had been out in the weather for a year or two. Recently, however, it has been demonstrated that the soil may be used several years and then reconditioned in place by steam sterilization.

Raised concrete soil benches permit steam sterilization of soil and eliminate repair bills

Concrete Soil Benches Become a Necessity

There is a surprising amount of accessory construction work in and around a greenhouse for which concrete is exceptionally well suited because of its ability to withstand the warm and moist atmosphere associated with this industry. Soil beds and benches comprise an important part of such accessory work.

In order to sterilize the soil tight benches are necessary, for the steam leaks from wooden benches to such an extent that the job can not be well done. So to save the expense of replacing wooden benches and to provide a tight holder for the soil, concrete was tried at the Kansas Agricultural Experiment station greenhouses.

Two Types of Soil Containers

Greenhouses use two types of soil containers. One is known as a bed. It is a pit in the ground, planked up to prevent caving of the sides and to hold the prepared soil in which the plants are grown. The other is known as a raised bench, or merely as a bench. This is really a long table. The legs of the bench are usually about three feet high and the walls are from four to eight inches high. It is in these benches that the soil is put and the plants are grown.

Building Concrete Soil Containers

With the beds there was not much of a problem. Instead of 2-in. cypress, a concrete wall was built. This wall was eighteen inches high above the ground and extended into the ground six inches. The base was made three inches thick and at the top two inches. The mix on this job was a 1:4, river run sand being used. Forms had to be built, but old bed walls and scraps found here and there served for that. It is therefore impossible to determine the cost of the forms, for they can be used over and over again. In our case the forms were used for eight beds and were then used for a temporary hotbed. Hog wire fencing was used for reinforcement.

Cost of Work

The cost of the materials was, exclusive of the forms, about $85.00. The lumber alone for wooden soil containers would have cost $45.00. The lumber job would have lasted not more than seven years, while the concrete containers, which were put in seven years ago, have so far not cost a cent in repairs.

The original cost of the concrete soil containers, then, is not much more than the wooden job would have been, and the permanency is a considerable item.

Construction of Raised Beds More Difficult

With the raised beds the problem was a little more difficult. We did not know how much of a load the concrete table would be required to carry, but did not want to make it so big and so expensive that it could not be used on a commercial scale. There was nothing to do but to try it out. Since 2-in. walls had done so well in the case of the bed on the ground we decided to try them with the bench.

Accordingly, one was built. For legs, 1¼-in. pipe, which is found around any greenhouse that has been built some years ago, were used. They were set into a block of concrete eight inches square and four inches thick. The bottom of the bench was made three inches thick, and the sides three inches thick at the bottom, tapering at the top, like the beds, to two inches. To carry the load until the concrete had set, and to aid afterward, ¾-in. angle irons were run across the benches from leg to leg. These, of course, were embedded in the concrete when it was run. The first raised soil bench built in this manner was put up six years ago and is so satisfactory that all our benches are now made that way. In these greenhouses concrete is replacing wood for nearly everything, except flats, and it is very satisfactory.

Concrete the Most Economical Material

Our experience with concrete in greenhouses indicates that it is cheaper than wood over a run of five years, and that each year after the five years it becomes increasingly cheaper. It is cleaner, for it provides no place for insects and plant diseases to hibernate. It saves on repairs and it improves the appearance of the house. Some of the additional advantages of the material are the labor and soil saved because the soil may be sterilized without damaging the concrete soil containers, larger crops can be grown, and there is a saving on the use of insecticides and fungicides.

Much Accessory Concrete Work in Greenhouses

Now all our beds, benches, work tables, side walls and door sills are made of concrete. As the amount of concrete has increased the repair bills have decreased. Last year the saving in labor alone amounted to the laying off in the summer of two full time men who used to spend their entire time from the first of June to the middle of September repairing the wooden beds and benches that had decayed in the warm moist atmosphere.

Curing Concrete Floors

Proper curing increases both the hardness and watertightness of concrete floors. Keep all doors and windows closed and the surface moist for 10 days by sprinkling before using the floor.

20-Year-Old Foundation Concrete Proves Permanence of Material

Back in 1908 the George A. Fuller Construction Company put in a massive concrete foundation for a building subsequently erected for the Farmers' Loan and Trust Company at William and Hanover Streets, New York City. The building went up fifteen stories, and stayed up while business in it and around it grew.

The old building recently was torn down, to make way for a seventy-one story affair. Naturally, the old foundation had to come out. The same construction company that put it in found itself faced with the job of removing it. All the modern equipment of foundation wrecking, from compressed air drills to dynamite, were called into play. But the great mass of concrete, good to begin with, had become stronger through the years. Even the most heroic and drastic measures failed to speed up the demolition process.

James Taylor, superintendent of construction for the Fuller Company, commented on the situation to a reporter for the New York *Sun.*

"This concrete," he said, "is of harder texture than stone. Instead of disintegrating during its twenty-one years, it has become harder and less impressionable, as all good concrete does. If it were permitted to stay in place for fifty years, its hardness would approach that of steel."

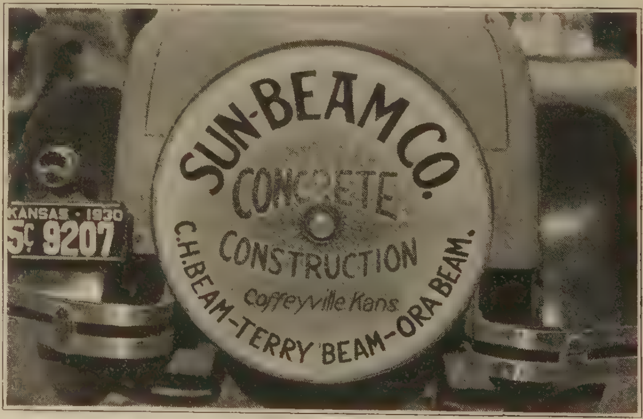
And thus is illustrated one of the unique qualities of concrete. Properly handled to begin with, it delivers satisfaction in a steady progression, increasing in quality.

It may be safely assumed that permanence is one of the things most people want—in concrete especially. Whether the concrete be a foundation for a bungalow or a skyscraper, or a material for the realization of a great public improvement, it is used because it "stays put" and gets better as time goes on.

Kansas Concrete Builder Advertises Business on Tire Covers

There is no doubt in the minds of people in Coffeyville, Kansas, and vicinity concerning the kind of business engaged in by three of the community's well known citizens —C. H. Beam, Terry Beam and Ora Beam.

These men do concrete work and advertise the fact on the tire covers of their automobiles. A sample of this kind of advertising is shown in an accompanying photograph of the rear elevation of Terry Beam's car.



As shown by the ad, the firm is known as the Sun-Beam Company and it specializes in concrete construction. Advertising of this kind is very effective, yet it is quite inexpensive.

Linoleum on Concrete Offers New Floor Possibilities

Use of Modern Linoleum Over Concrete Floors Gaining Increasing Popularity—New Designs and Colorings Make Its Use Appropriate in Every Room of the Modern Home—The Concrete Builder's Opportunity

THE concrete home with reinforced concrete floors is here to stay in more than one sense of the word. That this type of construction is finding increasing popularity may be clearly seen from the constantly growing number of dwelling houses of this type in nearly every section of the country.

The Answer to Old Question

Among the questions raised by the housewife or home builder who is considering concrete floors for the home are whether concrete floors will be cold and damp, and whether it will be possible to make them attractive and in keeping with the rest of the home furnishings. Regardless of whether there is any basis for these questions, they are often raised. Permanence, rigidity and the fire-resisting qualities of properly built concrete floors are beyond question. It is the element of comfort and appearance that has to be proved by the contractor recommending them.

Almost everyone knows that concrete floors eliminate much of the vibration caused by heavy city traffic and the unpleasant static of heavy footsteps on the floor above. But the matter of making these floors truly attractive is still a problem that not every building contractor has solved.

Modern Patterns and Colors

Many contractors have found that modern linoleum will frequently help sell the idea of concrete floors to the prospective home owner. Linoleum manufacturers now offer floor material in handcraft tile designs, rich marble effects, and many other types that make them suitable for installation in any room of the dwelling house or apartment.

Tile handcraft effect in the floor of an attorney's office in Indianapolis

Some Good Selling Points

But the use of linoleum floors is not confined to the home alone. Modern office buildings, hotels and stores have found that the combination of linoleum on concrete makes a floor that is admirably suited to their needs. One of the greatest advantages offered by this combination is the economy of upkeep. Improvements in the manufacture of linoleum, combined with better methods of installation, make these floors permanent in every sense of the word. All that is required to keep them clean and attractive is regular waxing with an occasional washing when the need becomes evident.

Beautiful tile pattern in linoleum floor in the dining room of a large residence in Los Angeles

For the average office building, the types of patterns that have been found most useful are the plain colored linoleums and jaspes; the latter simulates the striated effect of jasper stone and can be obtained in several unusually effective colorings. For the showrooms of retail stores, for doctors' offices or barber shops, patterned floors of flagstone or marble designs have been found most effective and popular.

Concrete Floor An Ideal Base

The concrete floor is usually well adapted for the application of linoleum, since it offers a smooth subfloor surface. Here is an important point that should be called to the attention of the builder, because the length of life of a linoleum floor, and the degree of satisfaction derived from such an installation, depend in a large measure on the type of subfloor available. Perhaps most of the complaints that are heard against linoleum as a permanent floor come from those who have seen it installed over an uneven base. The resilience of linoleum, a feature which adds to its comfort, demands firm support if the floor is to be even and free of cracks or bulges.

How to Lay Linoleum on Concrete

When a prospect has finally been sold on the idea of concrete floors with a linoleum finish, every precaution should be taken to see that the installation is properly made. Extensive experimentation has proved that a trowel finished concrete floor offers the best surface for linoleum. Where comfort is one of the first considerations, a layer of 1½-lb. lining felt should first be pasted to the concrete before the linoleum is laid. The felt layer method, however, has been developed primarily for taking up contraction in a wood subfloor. Before this method was discovered, linoleum was frequently disfigured by unsightly cracks due to warping and contraction in the wood. The solid nature of a concrete floor naturally eliminates the possibility of contraction and disfigurement in linoleum in this way. The cushioning effect of the layer of felt, however, is desirable, and if cost is not a matter of very great importance, the comfort derived is well worth the slightly greater expense involved.

Precautions Against Moisture

At this point one precaution should be definitely pointed out. While the linoleum cement which is used at the seams of the linoleum floor is waterproof, the paste which holds the larger part of the linoleum to the floor is not. As a result, when linoleum is installed over a concrete floor in contact with the ground, the adhesive is very apt to become affected by the moisture. This action is inclined to separate the linoleum from the subfloor and spoil the entire installation. For this reason, when linoleum is to be installed over a concrete floor slab lying directly on the ground, every precaution must be taken to thoroughly waterproof the concrete against the penetration of moisture from below. A good method is to see that the ground underneath the floor is well drained, and that a 6-inch layer of cinders is placed between the concrete slab and the soil.

Marble tile effect in the living room of a Kansas City residence

The Concrete Builder's Opportunity

Leading decorators the country over are recommending linoleum for every room in the modern house. Today in many of the very finest homes are found colorful floors of linoleum in every room, perfectly in keeping with the smartest of home furnishings. The tendency toward a wider use of this resilient floor material has gained considerable impetus and will very likely find an increasing popularity as years go by.

With the increasing use of linoleum floors in every room in the home come new markets for the concrete contractor, for concrete has many distinct advantages over any other type of subfloor.

The Public's Dollar—Who Gets It?

A recent article, "Finds Henry Ford Can Be Laundryman's Competitor," published in the financial section of "The Chicago Tribune," not only brings a message to the laundryman but to the concrete builder and others who are competing for the public's dollar.

In this article by "Scrutator," there is considerable food for thought. For example, the description of "competition" will undoubtedly interest those who are trying to sell concrete work.

"Competition used to be described," states the article, "as the attempt of two grocers on one block to sell two cans of beans to a woman who only wanted one. Today we know that competition is something vastly more intricate than that.

"The main question no longer is which of two or more individuals or firms shall fill an existing want, but whether the consumer chooses to satisfy that particular want or holds another more important.

"An example which is not fanciful may be given. A certain man bought an automobile and in order to meet his payments had to cut down his ordinary living expenses. One of the economies he effected was to wear a shirt two days instead of one. The laundry's competitor in this instance was not the other man in the same business, but Henry Ford and his organization."

The problems confronting the concrete builder or everyone who has something to sell apparently can best be solved by answering the question: "Who gets the public's dollar?"

It is evident that the concrete builder will have to institute aggressive sales methods, that he will have to convince the home owner that a certain concrete improvement will give more lasting satisfaction than a new radio, a washing machine, a vacuum cleaner or what-not.

In order to get his share of the public's dollar, the concrete builder certainly must use effective, honest means to see that the consumer holds his want for a certain concrete improvement more important than any one of his other wants.

Newspaper Notices Play Part in Promotion of Concrete Work

Many concrete builders have been successful in securing appropriate newspaper notices from time to time. These vary from particulars of a new job to statements outlining simply the nature of the service available.

An item published recently in a Norristown, Pa., newspaper speaks generally of the widespread use of concrete work, and continues in part, as follows, "William G. Schnell, contractor, of 713 Chain Street, who has been a leading cement contractor here for years, knows that prospective home and real estate buyers demand good concrete walks and other concrete features before they will think of buying.

"Mr. Schnell has his name imprinted on miles of concrete paving in and around Norristown. He specializes in all phases of cement work. His estimates can be had immediately, for he quickly figures them and cheerfully presents them upon request."

Fast Courts for Fast Tennis

Facts Concrete Builders Can Use in Selling Concrete Tennis Courts—Sales Aids for Use in Business-Getting Letters, Printed Matter or Advertisements

Through well-planned sales campaigns, backed by aggressive personal selling, many concrete contractors are developing a large volume of concrete tennis court business. Some of them send out sales letters to home owners, park superintendents, country club managers and others who are prospective buyers of tennis courts; other concrete builders follow up these letters with attractive printed matter describing concrete courts they have built. There are certain builders who place advertisements in newspapers, in magazines, and in other publications that reach prospective buyers of concrete courts.

To assist concrete builders in writing such sales letters, printed matter or advertisements, the following facts, any one of which is a good reason for using concrete for tennis court construction, are published. All of these facts need not be used in one letter, one printed circular or one advertisement; they may be the basis for a series of seven letters, circulars or advertisements, for that matter. The facts follow:

1. Many tennis players complain of the inaccuracy of poorly kept clay or grass courts. The concrete court is the answer. The criticism of hardness is offset by the testimony of many champion amateur and professional players, who maintain that a few sets will accustom any player to them.

2. Bill Johnston, a well-known tennis player, writes: "From a personal standpoint, I like the concrete courts very much as the action of the ball on the court is better suited to my game than any other kind of court. It is better for beginners to learn the game on a hard court, as their strokes are speeded up; and success today is largely based on speed."

3. Thousands of concrete courts are in use throughout the country. Minneapolis has more than 50 and is adding to the number. Many of the best clubs provide them. Some of their advantages are:

a. No Maintenance. Once built, the concrete court is self-sustaining. No rolling and tamping, sprinkling, taping or line painting. Four clay courts will keep one man busy the year around; this expense would pay for a concrete court.

b. All-Year, All-Time Sport. Clay and grass courts are out of commission due to rain and snow more than half the time. Five minutes after a rain storm a concrete court is ready for use. People tell of clearing snow off a concrete court on a sunny winter's day and playing several invigorating sets.

c. Always in Good Condition. Even with much care and attention, clay and grass courts get bumpy and at best are often inaccurate. Concrete courts are smooth. They make a fast, accurate game.

d. Cost Not Excessive. Concrete courts can be laid at a cost ranging, in the extremes, from 15 to 25 cents per square foot. On a 60 by 110 foot court this cost is from $1,000 to $1,650. Any difference between this figure and the cost of a transient type court will be more than paid for in upkeep in a very short time.

"Cement Work That Lasts a Lifetime"

This is the recommendation, the guarantee that R. E. Masters, of Columbus, Ohio, has always given for his concrete work.

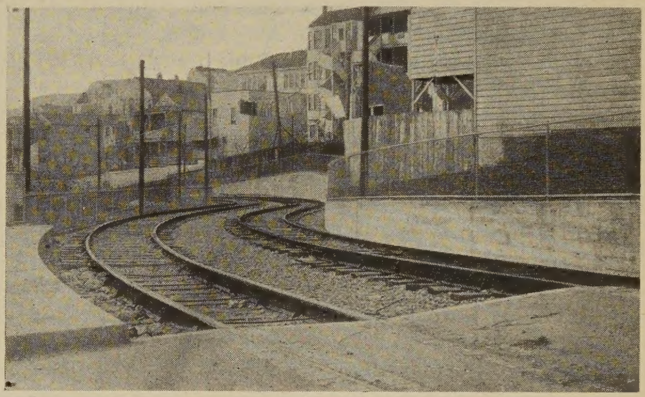
It is interesting to note that Mr. Masters became established in the concrete contracting business in 1882, when the material concrete was really in its infancy. From that time until his retirement recently he was engaged in building concrete sidewalks, basements, porches, steps, floors and other similar concrete work. Today his son is carrying on the business.

Mr. Masters and his son are widely acquainted in Columbus and vicinity. They have built up an enviable reputation, principally because of good materials, honest workmanship and an earnest endeavor to produce lasting jobs. During his career as a contractor, Mr. Masters found that aggressive salesmanship was an important asset to his business. Likewise, his son is following in his footsteps by really selling concrete work. The recommendations of previous customers, his father's reputation, and good work done in the past are the basis of his principal sales aids.

It has been said of him that "by honest, faithful workmanship and a wide reputation for doing good work, Mr. Masters is now independent and able to retire from active work."

Monolithic Concrete Walls for Right-of-Way

The accompanying illustration shows the monolithic concrete retaining walls which enclose the private right-of-way of the San Francisco Municipal Railway between Eighteenth and Twenty-second streets. The wire fence supports are embedded in the top of the walls. At the left is a concrete loading platform for passengers.



Concrete Floors for Corn Cribs

C. A. Lawson, who has been in the concrete contracting business at Monroe City, Missouri, for 25 years describes his method of building ratproof floors for corn cribs, as follows:

"I build a concrete wall 8 in. thick to conform to the outside lines and 18 in. above the ground. Before the concrete sets bolts should be pushed into the concrete with about 4 in. protruding so that the wood sills can be bolted or securely fastened. This keeps the building from tipping over if a tornado should hit it.

"After the wall has hardened the space inside is filled with rough rock that is found here along small streams. The surface is leveled off with small stones to within 3 in. of the top so that it is smooth and all large holes filled in.

"The surface is then covered with concrete mixed as stiff as it can be worked and finished off with a wood float and steel trowel. With this sort of construction no reinforcement is needed in the floor as there is no settlement. Dirt fills sometimes give trouble with the floor cracking and are not usually as dry as a floor built over a rock fill."

The Concrete Industry
—25 YEARS AGO

AN article entitled "Reinforced Concrete Floors in Practice" and published in the issue of May, 1905, says, "The recent test of reinforced concrete floors at the new North American Cold Storage building at Chicago is remarkable in its demonstrations of the strength of this class of construction under practical conditions."

An account follows of the design, proportions and reinforcing, and the article concludes with an outline of the testing of two panels with pig iron.

* * *

CONCRETE blockmakers are advised that a proportion of 1 part of cement to 4 of sand is considered about the average and necessary requirement.

"If the sand consists of mixed grains, fine to coarse, the above proportion of 1 to 4 will make good dense block provided the concrete is well mixed, machine mixing preferred, and thoroughly tamped. However, if the sand is composed of grains of rather even size a 1 to 3 mixture is recommended," an item under "Proportions of Concrete" states. "Where a fine sand, which is usually of uniform grains, is used for the facing of blocks," it continues, "a mixture of one part of cement to two parts of sand is about the correct proportion. In this case a much leaner concrete, say one part of cement to six or seven of gravel can be used for backing," it concludes.

* * *

THE exceptional length of a 102 ft. girder in a Los Angeles warehouse is cited as a noteworthy example. CONCRETE of 25 years ago states that, "This building covers 104 by 150 ft., and as originally designed was to be built of 17 in. brick walls with 25 in. piers, 16 ft. 6 in. on centers and covered by a steel truss and corrugated iron roof of 100 ft. span.

". . . Considering that the roof had to carry a suspended gallery and that means had to be provided for lifting heavy weights and eventually to suspend tracks for light traveling cranes, the idea of an arched roof was discarded and straight girders of 102 ft. span decided upon."

* * *

CONSIDERABLE space is devoted in the May, 1905, issue of *Cement Age* to the Pugh Power Building, then under construction in Cincinnati. The 45 in. slope of the site resulted in the following dimensions: width, 68 ft., length, 335 ft., and height, 129 and 159 ft.

* * *

WHAT was heralded as the first use of reinforced concrete for car barns is described in an article concerning a structure at Harrisburg, Pa.

The use of form work is described as follows: "The possible simplicity of design from an architectural point of view for a building of this nature, and the multiplication of the units of which all the buildings are composed, lend themselves especially to concrete construction as the cost of forms in such cases is cut to a minimum, this cost alone amounting in the present instance to something like 30 per cent of the total. The lumber for the forms of the car barn, which was constructed first, was entirely used for those of the repair shop, now under construction, the only additional lumber necessary for the latter being 7/8 in. stuff for the roof slabs.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.
Thirty-third annual meeting, June 23rd-27th, Chalfonte and Haddon Hall hotels, Atlantic City, N. J.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Haydite Manufacturers' Association; Dan F. Servey, Secretary-Treasurer, 203 Mutual Building, Kansas City, Mo.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Concrete Products Association; Jack Franklin, Secretary, 425 East Water Street, Milwaukee, Wis.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

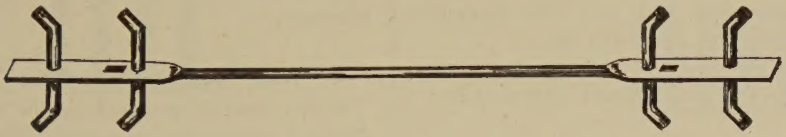
Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.
Semi-annual meeting, May 9th, Commodore Hotel, New York City.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer,3115 Plankinton Arcade, Milwaukee, Wisconsin.

New Equipment and Materials

"Perfect" Form Tie and Spacer Eliminates Wiring

The "Perfect" form tie and spacer is designed to do away with the necessity of wood spreader blocks and to eliminate the wiring of forms, by acting as a positive tie for each board.



Forms are automatically spaced and it is claimed that a saving of 50 per cent in studs on one side and 50 per cent in all nailing is made.

"Perfect" form ties and spacers can be furnished for any thickness of wall from 6 to 24 inches and a variety of stock sizes is maintained.

The Perfect Form Tie Mfg. Co., Los Angeles, Calif., manufactures the device.

Bantam Hoist Is Light-Weight Unit With High Capacity

The hoist and crane division of Robbins & Meyers, Inc., Springfield, Ohio, announces the new Bantam hoist, the most recent addition to its line of electric hoists. The Bantam is said to be the smallest, lightest, and most powerful hoist with reference to size and weight on the market.

Among the Bantam's outstanding features are the following: (1) Light weight —130 pounds complete with trolley, 110 pounds without. (2) Small size—overall dimensions of 18 by 24 by 14 in., resulting in unprecedentedly low headroom. (3) Speedy operation—30 ft. per minute, and (4) 500 pound capacity.

The Bantam hoist is manufactured in styles suitable for use on alternating and direct current circuits with either rope or push button control; the latter is a newly patented simplified and centralized system. The Bantam frame is designed to permit the use of the standard I-beam trolley or any make of monorail trolley.

Preservative Coating for Contractors' Equipment

A preservative coating sold under the trade name, Rust-oy, and manufactured by the Williams Alloy Products Company, of Elyria, Ohio, since 1921, is said to have found extensive application in the preservation of contractors' equipment.

The manufacturers claim that Rust-oy is not a paint and that it penetrates through a coating of rust to the metallic surface underneath and seals it against further atmospheric action, thereby preventing more rust. Because of this ability to penetrate rust, it is not necessary to remove rust before applying the coating.

Rust-oy may also be used as the priming coat for paint coats. In fact, any other coating such as paint, varnish or enamel may be applied on top of it if desired.

Acqua-Pruf Is Workability Agent Used Integrally

One of the agents being used to supply fatty mortar and promote flowability is a chemical compound known as Acqua-Pruf. It is used integrally.

Acqua-Pruf, Inc., Bradley Beach, N. J., manufactures the product.

Duplex Machine Supplies Concrete Flower Pot Demand

One of the few machines of its type available anywhere, the Duplex flower pot making unit, shown at the right, is of interest to those who find or foresee a demand for concrete flower pots.

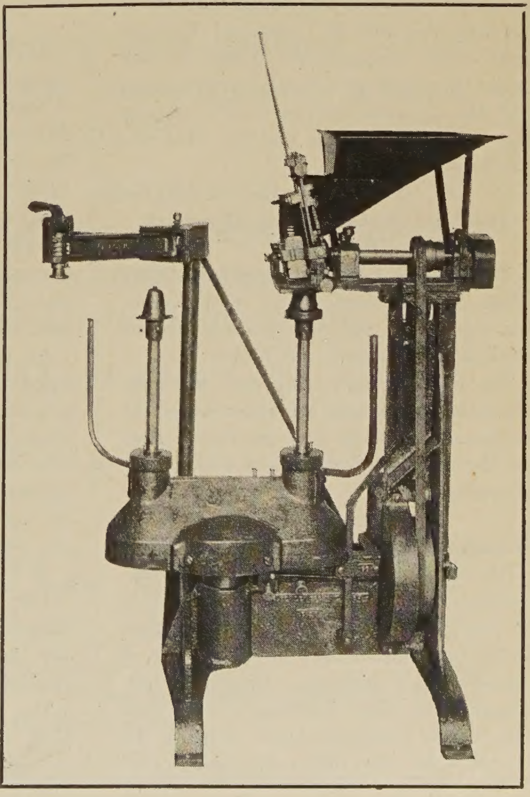
While present pot manufacturers report that some selling is necessary in many cases, in others nurserymen have readily adopted concrete flower pots and found them satisfactory and advantageous in many ways.

According to the manufacturer, one sack of cement and two and one-half parts medium grade sand will make 2,000 2-in. pots or 20 12-in. pots, or intermediate sizes in proportion.

The machine is made of cast iron and steel. Adjustments for different sizes of pots, from 2 in. up to 12 in. are said to be simple. The 1:2½ mix is placed in the hopper and as the forms revolve the mixture is fed automatically into the forms and automatically tamped. Power is furnished by a ¼ hp. motor attached to an electric light socket or small gasoline engine.

A set of forms consists of that for the outside of the pot, a core for the inside and rim, and a bottom piece.

The Portland Concrete Machines Co., Chicago, Illinois, is the exclusive sales agent for the United States east of the Rocky mountains.



Auto-Gage Is New Moisture Determinator

The Toledo aggregate moisture determination Auto-Gage has been designed for use in determining the percentage of moisture in sand. The device is so arranged that difference in weight of dry and damp sand is indicated on a chart graduated to show directly the percentage of moisture to actual sand in the damp sample. If, for example, the sample of damp sand contains 80 parts of actual sand and 20 parts of water, the index automatically indicates 25 per cent, showing that in the sample there was 25 per cent as much water as actual sand.

Additional circles of graduations on the chart make it possible to use the device for determining specific gravity and for indicating percentages in sieve analyses.

The Toledo Scale Company, New York City, manufactures the Auto-Gage.

About Makers of Equipment and Materials

Notes From the Field

Carr Appointed P. T. L. Engineer

Pittsburgh Testing Laboratory, Pittsburgh, Pa., has just announced the appointment of *M. L. Carr* as staff engineer.

Mr. Carr will act as an engineering consultant and co-operate with clients in helping to solve problems relating to purchasing, production and sales.

Announces Correct Use of "Carborundum"

The Carborundum Company of Niagara Falls, N. Y., in its campaign against the tendency to use the word *"Carborundum"* as a common description announces that the word "Carborundum" is a trade-mark of this company, registered in the United States and foreign countries and is applied by it to its range of products: abrasive, refractory, mechanical and electrical. The Carborundum Company states that the proper term is silicon carbide and that this is the form that should be used unless a specific Carborundum brand product is referred to.

Presdwood Representatives

Announcement is made by the *Masonite Corporation,* Chicago, of the appointment of *E. L. Cochrane* and *D. J. Johnson* to promote the sale of Presdwood for concrete form linings. Mr. Cochrane will cover Ohio and as far east as Pittsburgh and Mr. Johnson's territory will comprise the state of Wisconsin and St. Paul and Minneapolis.

DeWalt Takes Over Wodack Products

The DeWalt Products Corporation, Lancaster, Pa., has acquired the Wodack electric hand saw and the Wodack electric combination mortiser and router.

The DeWalt engineering staff and manufacturing advantages are available for the production of these new products. They will be distributed through a national organization.

Harshaw Moves to Own Building

The Harshaw Chemical Company, manufacturers of chromium green oxide, said to be the only permanent green pigment known, and distributors of a full line of concrete color pigments, have just purchased a four-story building at 1945 East 79th Street, Cleveland, Ohio, to house the executive and sales offices and laboratories.

The move was made necessary when their most recent quarters in the Hanna Building in Cleveland were outgrown.

Pettibone Pavement Licensee

L. A. Pettibone has taken over the promotion and construction of sheet concrete pavements as authorized licensee for the *Sheet Concrete Pavement Corporation* of America, New York City. His headquarters will be in Pittsburgh, Pa.

Mr. Pettibone was formerly a consulting engineer for the Portland Cement Assn.

Autocar Sales Manager

H. M. Coale, vice-president in charge of sales of the *Autocar Company,* Ardmore, Pa., has announced the appointment of *E. F. Sayers* to the position of assistant sales manager in charge of branch operations.

Industrial Literature

Overhead Materials Handling

A new leaflet on overhead materials handling issued by the *Cleveland Electric Tramrail division* of the *Cleveland Crane and Engineering Co.,* Wickliffe, Ohio, is entitled, *"How You Can Use the Modern Idea for All Your Bag, Box, Bale, Barrel, Bundle Handling."*

Ace Trolley Bulletin

The new Ace trolley in plain and geared types ranging from ½ to 20 ton capacity is announced in *Bulletin* 5025 by the hoist and crane division of *Robbins & Myers, Inc.,* Springfield, Ohio.

Sika Waterproofing Products

Sika waterproofing compounds were introduced to American users at the recent New York Home show by the *American Sika Corporation,* New York City.

Its manufacturers describe Sika as integral waterproofing used for fifteen years in Europe. One of the claims made for the products is that they are effective in acting as a barrier to gushing water, having the capacity to permit setting of concrete under agitated water, in thirty seconds.

"Know the N. E. C."

The National Equipment Corporation, Milwaukee, Wis., is distributing widely a new broadside illustrating the principal products which it manufactures.

The publication is entitled *"Know the N. E. C.,"* and lists the 54 different items of equipment produced.

Irox for Waterproofing

Complete information on *Irox,* a bonding and waterproofing compound, is contained in a folder recently published by the *U. S. Waterproofing Company,* Chicago.

Its application and effect on durability and preservation of concrete are told and a diagram illustrates the waterproofing of a basement.

New Aquagel Booklet

A new booklet prepared by the *Silica Products Company,* Kansas City, Missouri, is *Bulletin No.* 105, entitled "Aquagel in Cement, Mortar and Concrete."

This is a 32-page publication telling how to effect more water-resistant concrete by the use of the admixture.

Reasons for Joist Construction

The basic economic advantages of concrete joist construction are outlined in a new four-page folder recently published by the *Concrete Reinforcing Steel Institute,* Chicago.

New Spray Painting Catalog

A new edition of the *DeVilbiss Spray Painting Equipment Catalog* has just been issued and is now available.

This is a 32-page publication, prepared by the *DeVilbiss Company,* Toledo, Ohio.

Fisher Publication

A new issue of "The Laboratory," containing interesting matter of a scientific character, is being distributed by the Technical Service Department of the *Fisher Scientific Company,* Pittsburgh, Pa.

Handbook and Price List of Protective Products

The Ceresit 24-page handbook and price list, just issued by the *Ceresit Waterproofing Corporation,* Chicago, gives concise and complete information regarding thirty products by Ceresit. It contains useful information covering all classes of waterproofing products, colored cements, asphaltic materials and similar protective products.

Ceresit, as is generally known, is a product of German chemists and prior to its introduction to the United States was made in Germany.

The Ceresit handbook, in addition to containing complete data regarding Ceresit products, includes other valuable tables and will be sent to anyone in the building industry.